THE

# ELECTRICAL REVIEW.

VOL. LVII. DECEMBER 8, 1905. No. 1,463.

## ELECTRICAL REVIEW.

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THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

*The Oldest Weekly Electrical Paper. Established* 1872.

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OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
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Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE
UNIVERSAL ELECTRICAL DIRECTORY

1906 Edition
NOW IN PREPARATION.

N.B.—Advertisements and Corrections should be sent in at once.

H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

## THE BOARD OF TRADE AND OVERHEAD MAINS.

So much misapprehension exists, we believe, with regard to the use of overhead mains at high pressure in this country, and the attitude of the Board of Trade towards it, that we have thought it advisable to collect some information on the matter for the benefit of our readers. In view of the work which has already been carried out in this connection, and the proposals described in our last issue, the importance of the subject cannot be ignored. It is only within recent years, however, that it has come to the front, the first definite instance of powers being sought to carry such lines over public roads, &c., being found in the case of the Gloucestershire Electric Power Co., which was formed in 1902 to generate and distribute electrical energy for motive power in part of the county named; but high pressure overhead lines had previously been used on private property.

Very special reasons depending upon the local conditions rendered the use of overhead mains essential to the success of this undertaking; the area scheduled was conveniently arranged for supply, the works from which a demand was anticipated being distributed along narrow valleys, but cheapness was a *sine quâ non*, and it was found impossible to quote low enough rates with underground cables, which cost twice as much as overhead mains. Moreover, the visible presence of the overhead lines would constitute an excellent advertisement, and it would be possible to put up light and inexpensive lines at first, which could afterwards be replaced by heavier cables, whereas the high cost of laying underground cables renders it imperative to put in heavy sections from the start. In fact, the true ratio of cost, for the first two or three years, would have been more like 5 to 1 than 2 to 1.

Mr. G. L. Addenbrooke, engineer to the company, approached the Board of Trade on the matter, furnishing full particulars of the scheme; the Board required full details and proof that the cost of underground mains would be prohibitive, as well as proof that the commercial importance of the scheme justified the use of high pressure. It was proposed that the best Continental practice should be followed. The provision of a separate low-pressure distributing system was considered, but was found to be too costly, involving twice as much overhead work, and increasing the cost of supply over a distance of only half a mile by no less than £1 per annum per kilowatt. The company represented that opposition to the use of overhead wires on the part of the Government would be impolitic, and would be the cause of great loss to the country. Nevertheless, it was not until July, 1903, that the sanction to use overhead wires was given, and then only for sparsely populated districts. It is important to note here that at no time was the somewhat hostile, or at any rate discouraging, attitude of the Board of Trade due to the advice of its technical staff, which was distinctly favourable to the scheme. The real difficulty

lay in disturbing a long-established ruling. The very fact that no attempt had been made to get this ruling altered made it more difficult to established a precedent for high-pressure overhead conductors.

However, thanks in the first instance to the efforts of the company above named, the attitude of the Board has been greatly modified, and although it retains a strong preference for underground mains—and rightly so, where the conditions are suitable—since 1903 it has sanctioned several other schemes involving the use of overhead mains. Inquiries made of the various undertakers, which have been most courteously answered, have elicited the following facts :—

No difficulty has been met with in obtaining sanction for overhead transmission at high pressure. On the contrary, every facility has been granted. In each case the full voltage asked for (up to 30,000 volts) was allowed, and, while details of construction have been closely examined, criticised, and in some cases amended, in no case were the designs for the overhead work objected to by the Board.

The projects sanctioned include lines up to 24 miles in length, and powers of 6,000 and 8,000 H.P.

No delay in carrying out the work has been caused by the action of the Board of Trade, and very little by that of the local authorities.

As regards wayleaves—perhaps the most delicate matter—as a rule but little difficulty has been experienced ; but some landowners have refused permission to take the mains over their property, thus necessitating deviations from the route first contemplated, and others, especially in agricultural districts, have imposed conditions and restrictions, which in some cases have even rendered the use of underground mains preferable.

In each case provision is made to prevent people from climbing the poles, such as barbed wire or spiked collars, and danger notices. Cages are used to prevent wires from falling where the lines cross roads, railways, &c., and such crossings are avoided where possible. Guards are also used to catch the conductors in case of failure of the insulators. The work is in every case of the highest class, and the route will be patrolled continually.

It is clear, therefore, that the use of overhead high-pressure mains in this country has now left the abstract and entered the concrete stage, with the full approval of the governmental authorities. Attention may be drawn to the articles which appear on other pages of this issue in illustration of this fact. While, as we are informed by one of the most competent authorities, it is more than questionable whether overhead transmission will be adopted for permanent use in this country—except, of course, in mountainous districts such as that of the North Wales Power and Traction Co., Ltd.—there is no doubt that in the early stages of a power distribution undertaking, when the turn-over is small, and the capital charges of great consequence, the low first cost of the overhead construction is a strong point in its favour. To this must be added the advantages mentioned at the commencement of this article, which render the system peculiarly well suited for the purpose of "prospecting," testing the demand of a district, and attracting inquiries from possible customers.

Especial interest attaches to the question in view of the proposal to transmit electrical energy to London from St. Neots. In this case the circumstances are exceptional. The primary transmission will be carried out at a pressure of not less than 20,000, and probably 30,000 volts, rendering the use of underground cables out of the question. But here the transmission line will be carried for almost the whole distance on a private right of way, and thus a great part of the difficulty will be solved from the start. In this connection it is interesting to note that in the United States, where California has hitherto held the lead with regard to long transmissions (the chief lines being 142 and 147 miles long, and minor lines no less than 232 miles), the State of New York, according to the *Electrical Review* of New York, is about to occupy the premier position. Power from Niagara will shortly be available at Syracuse, 145 miles distant in a direct line, and may be carried further to Utica or Albany. The Falls of St. Lawrence are also available, at similar distances, and ere long New York itself may be supplied from one or other of these sources.

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**An Objection to Steam Railways.**

Perhaps owing to an impetus from the pushful ha'penny morning papers, our revered and old-established contemporary of Shoe Lane—the *Standard*—seems to have taken on a new lease of life, and shows unaccustomed energy and go-a-headness, where of old one looked for stodgy respectability and ten-day-old news. Its "Commercial Page" has now become one of considerable usefulness, not least by reason of the special articles by special writers, to be found thereon ; and we shall have occasion to call the attention of our readers to more than one of these articles, and the subjects to which they refer.

For instance, the *Standard* points out in a recent issue the essential features of an Act passed during the present year for the purpose of throwing upon railway companies the burden of compensation for damage done to crops, fences, or other agricultural properties by means of sparks or cinders from passing locomotives, though one would feel tempted to consider our contemporary to be biased in favour of the agriculturist from the naive way in which it speaks of the law as being "altered for the benefit" of large numbers of persons at present unaware of the change.

We do not propose to argue all the pros and cons of this Act or its probable results. Doubtless, many farmers, especially of the poorer and smaller class, have suffered very much from loss of hay crops or damage to fences, &c., in this way, and that, probably, from no special fault or neglect of their own. But it is no argument to say that the railway company is better able to bear the cost, and should, therefore, be called upon to do so. If the same thing is to be said with regard to other conceivable causes of complaint (*e.g.*, noise due to escape of steam, excessive shunting, &c.), our railway companies may as well resign themselves, not merely to the absolute loss of dividends hardly enough earned as it is, but even to the possibility of stopping altogether rather than be shot at by all and sundry.

Even if the new Act limits claims to amounts under £100, it opens the door to another prolific system of spending money in fighting or settling claims perhaps not always well-founded ; and a possible sequence may be demands from the public for protection in other ways and in other directions.

So far as the railway companies are concerned, it should make them consider still more seriously the adoption of electric services to replace steam traction, wherever this is at all possible.

One cannot, unfortunately, lay down the general principle that the steam trains and lines most likely to create mischief in this way are just those which can be soonest and most easily replaced by electric services. Any observant traveller will be able to say that the worst offenders in the matter of cinder and spark throwing are the big express passenger and goods engines on the long-distance trains, which admittedly will be the last to suffer abolition in favour of electric cars. There may, however, be something in the theory that nearness to towns and cities makes the suburban farmer more inclined to exact his full rights than the (presumably) more unsophisticated countryman. In any event, the railway companies should look forward to avoiding trouble in this way along their electrified suburban lines ; and as for the main lines and long-distance traffic, they must—until such time as these can be profitably converted—see to it that the

best mechanical contrivances are used to prevent sparks and cinders being thrown out of the locomotive chimneys.

There is, besides all this, an additional indirect result of the new Act which we fear may have some effect on electric power supply. Most generating stations would like to be in the position of having statutory authority to make smoke or vibration if they do it in a reasonable way in the conduct of their business, and after taking reasonable precautions against such a contingency, or, to put it in another way, they do not want to be indicted by reason of possible smoke or vibration. If this new Act represents a tendency in legislation, there is not much hope that generating stations will have more consideration than railways. One cannot, however, generalise about them, as their individual rights and powers may vary considerably. It is enough to point out the bearing of the new Act, both direct and indirect.

---

**Heat and Temperature.** It is often very difficult to get men to think alike on mere physical matters such as the relation of heat and temperature. When a brisk fire is burned on a grate, there is an appearance of higher temperature than when the fire is burning slowly. So long as the weight of air passed through the furnace per pound of fuel is alike in either case, the temperature should be identical; but no fire can burn without losing heat by radiation, and a very small fire loses heat to a greater proportion of its total generated heat than does the larger fire, so that the temperature of the former is actually reduced to some extent.

In the case of independently fired superheaters, entirely useless attempts are made to protect the small tubes of uncontrolled superheaters by the use of smaller fires. Now the effect of this is that in the first place, the first tubes of the superheater are still exposed to practically the full temperature, and perish. Secondly, that the small fire produces an insufficient quantity of heat to supply the desired temperature to the steam. As a result of this dilemma, we find superheater makers compelled to use the larger fires in order to obtain quantity of heat, while they admit double and treble the necessary volume of air in order to moderate the temperature so that the earlier tubes may not burn out. But this large excess of air carries with it an equally large amount of waste heat, for the final temperature of the gas cannot be less than, perhaps, 700° F. Consequently the waste heat is very great, and its temperature is not such as to make it very useful in a feed heater. The common type of superheater cannot avoid these difficulties. If a given degree of superheat is to be secured, there must be so much coal burned, and so much excess of air employed to prevent danger to the tubes. This explains why, with superheat, an engine may show 20 per cent. economy, and only 5 per cent. may show in the coal heap. Obviously, therefore, if the engine economy of superheat is to be secured at the coal heap also, the furnace efficiency of the superheater must be equal to that of the boilers. There must be no unscientific admission of useless cold air. In order to render this possible, the high temperature of the gases must be toned down by absorbing their heat by water tubes placed between the furnace and the superheater, and the tempered gases from a large fire may then be poured through the superheater.

The water control pipes of a controllable superheater, which are contained inside the superheater pipes, then serve for the temperature control element of the superheated steam. In this way a separately-fired superheater may have a large fire, so that there is plenty of low temperature (1,400° to 1,600°) heat available for superheating, and yet none of its heat is wasted in heating an avoidable excess of air. By these means the engine economy due to superheat is extended to the coal heap, and only in this way can it possibly be made to do so.

The whole problem is one of clearly distinguishing between quantity of heat and temperature or intensity. Unless and until engineers are willing to distinguish more accurately between heat and temperature and all that this means in reference to rates of combustion and quantities of fuel, there can be no really sound appreciation of what superheat can do, nor of how it can be produced and controlled. The problem is simple enough if the principles of heat are clearly grasped.

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**In Dreamland.** We recently received, and also saw published in a trade journal, a report of a most ignorant and audacious character upon the merits of a certain perpetual motion machine whose fallacies we ourselves exposed in 1901; and this report was signed by an individual who appended to his name the sacred letters "M.I.C.E."

Aghast at this, to us, profane association, we examined the list of members of the Institution of Civil Engineers for the past 20 years, but could find no indication that the individual in question had ever been a member of the Institution. Under the circumstances, we thought it desirable that the attention of the Council should be drawn to the matter, with a view to visiting with condign punishment the unauthorised use of the letters. We were astonished to find, however, that the utmost action likely to be taken was to demand an explanation, and that, if an apology were forthcoming, the incident would close with a mild injunction not to do it again!

We have from time to time deplored the sleepiness of the Council of the Institution of Electrical Engineers in matters affecting the interests of the profession; and it is disheartening to find that even the Civil Engineers seem also blind to the importance of upholding the dignity and honour attaching to membership of their world-famous Institution. The policy of *laissez-faire*, in this as in so many other matters, has seized upon our leaders, and, as the Prince of Wales so clearly pointed out in his famous "Wake up, England!" speech, it is sapping the energy of the nation. Would that we could suggest a remedy.

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**Electricity and Fire Risks.** Protesting against the oft-recurring baseless suggestions, generally originating in the imagination of an irresponsible reporter, that such and such a fire was "due to electric wires fusing," is a weary and, perhaps, unprofitable task. It is with pleasure, therefore, that we turn to a brighter aspect of the fire risk question. Our readers will remember that in the disastrous accident which took place on the Great Eastern Railway at Witham, on September 1st, one of the coaches was destroyed by fire.

The report of Lieut.-Col. V. G. von Donop to the Railway Department of the Board of Trade has just been published, and it is interesting to observe that the inspector calls attention to the fact that the fire was due to the ignition of gas, which was used for lighting the train. The danger of an excruciatingly painful death by fire is one of the most awful risks attendant upon personal injury in a railway accident, and it is not to be wondered at, therefore, that the inspector points out the desirability of adopting some other mode of illumination, such as electricity.

As a matter of fact, electricity is absolutely the only safe means of electrically lighting a railway train, and now that such excellent systems are available for applying it, there is no excuse for the use of any other illuminating agent. We look forward to the time when the Government will make its adoption compulsory, and thereby improve the lighting, reduce the cost, and abolish this horrible danger.

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## ELECTRIC CARS AT OLYMPIA.

[COMMUNICATED.]

At the recent Exhibition of motor-cars at Olympia, London, there were some hundreds of petrol and steam cars shown, but the electric cars did not number twenty in all. The reasons for this are not quite clear, but one obvious cause and reason why electric cars have not made more headway, particularly in this country, is the difficulty of getting a re-charge, a difficulty considerably increased by the absurd and ludicrous action of our Board of Trade in allowing the hundred and more different voltages and systems now in use, instead of the standard or standards of voltages as adopted in other countries. This error has acted to the detriment of English electrical engineering, and more than any other cause has put this old grandmotherly, decaying and unemployed country into the position it now holds as a fourth-rate field for electrical enterprise, only kept alive by the devotion and energy of the men who have had to live with it.

Quite recently the Chief Commissioner of Works has been good enough to open a rift in the clouds, and to allow electrical vehicles the privilege, over petrol cars, of running in the Royal Parks during all hours—a privilege which they have earned by the marvellous comfort, freedom from smell and vibration, and other advantages they undoubtedly and admittedly possess.

Fig. 1.—Krieger Coupe.

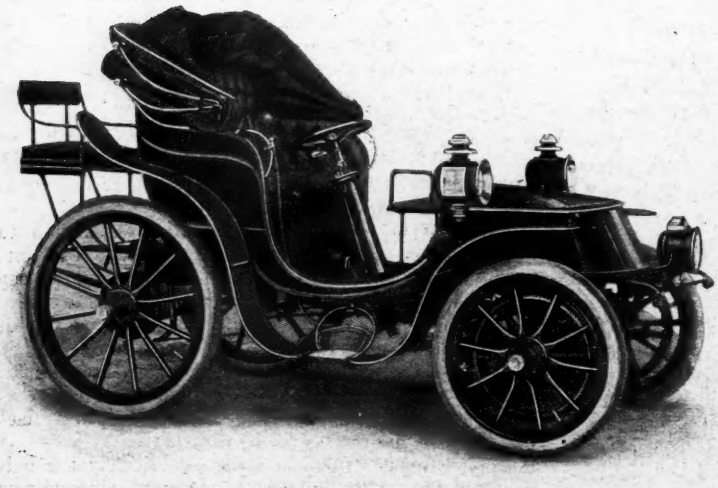

Fig. 2.—Krieger Victoria.

The electrical cars exhibited at Olympia this year, as may be easily understood, do not show any great advances over the cars exhibited last year; it is simply a question of demand and supply.

Fig. 3.—Oppermann Electric Landaulette.

The electric landaulette of the Electromobile Co., Ltd., of Curzon Street, London, is well known and is an almost perfect car. This company exhibited several of these really beautiful carriages, as well as a chassis, showing motor, battery, &c. Those who have ridden in these cars can testify to their excellent running qualities and ease of control, but they are heavy—nearly 2 tons, complete—and are proportionately costly in upkeep. The company has not apparently made any progress towards providing a reliable, light and comparatively inexpensive car suitable for the many. The company now fit their landaulettes with an 8-H.P. electric motor (speed 1,500 r.p.m.), in place of their earlier practice of a 4-H.P. motor, to provide the additional power required for the increase of speed from 14 to 20 miles, allowed under the Motor-Car Act of 1904. The motor being of larger size, has necessitated a new arrangement for suspension and buffer springs. Imitation being the sincerest form of flattery, it says much for the Electromobile Co.'s landaulette, that the makers of petrol landaulettes have almost exactly copied their design in many of its features, including the scolloped front dash, &c.

This company make their battery on the car about 33 per cent. of the total weight; theoretically, this is the most economical proportion of carriage, battery and load.

The Electromobile Co. apparently not finding sufficient outlet for their electric carriages are making petrol cars, as other electrical firms are doing; of course, under more favourable conditions as to charging their batteries, they, like the proverbial cobbler, would probably have stuck to their last, and have expanded their electric carriage business.

The Kriéger Electric Carriage Syndicate, Ltd., of 8, Victoria Street, Westminster, had a most attractive show of electric carriages, and, as is well known, the Kriéger system is one of the oldest, for the firm were amongst the first in the field to make electric carriages. The illustrations show two of their exhibits, and as will be seen the front wheels are of smaller diameter than the rear wheels; the front wheel drive allows of this, but it is

of doubtful advantage as the upkeep of tires may be greater, and the different sizes must be somewhat inconvenient.

These carriages are also weighty, and their upkeep costly; on the other hand, they run perfectly smoothly, and are luxuriously comfortable.

Two electric motors are used, each gearing into one of the two front wheels by means of a pinion and an internal toothed wheel. These motors are supported by a flexible spring fixed radially to the axle, giving an easy drive and softening the shocks of starting and stopping. The battery consists of 44 Fulmen cells of 180 ampere-hours capacity, and weighs about 13 cwt., the weight of the carriage with battery being about 30 cwt., and the stated run for one charge, 30 to 40 miles. The Kriéger system of control has the advantage of recuperation at 40 volts (batteries in parallel), and also at 80 volts (batteries in series).

The Carl Oppermann Electric Carriage Co., Ltd., of Underhill Street, Camden Town, N.W., exhibited a new form of chassis, which we illustrate, together with a complete electric landaulette. It will be remembered that the Oppermann Co. has for some years fitted a worm wheel drive to their carriages, but this has now been superseded by the more efficient chain drive, with an advantage of approximately 10 per cent. saving in the battery power.

The new features of this chassis are the method of suspending the battery in two trays and of driving from the motor in or near the front by means of Renold's saw-tooth chain on to a live back axle; gear ratio about 8 to 1·1. The motor, of the four-pole enclosed type with laminated fields, is rated by the Oppermann Co. at 6 H.P. at 700 r.p.m.; it has a single commutator with two carbon brushes. The battery consists of 44 cells of the A.B.C. pasted plate type, and weighs about 12 cwt. The controller is much simplified and reduced in size, but the advantage of making this small, taking into consideration the heavy current dealt with, often 100 amperes at 80 volts, is doubtful, and Messrs. Oppermann may find trouble at this point. The whole arrangement of chassis is most workmanlike, and the design of the carriage and its running qualities are excellent.

*(To be concluded.)*

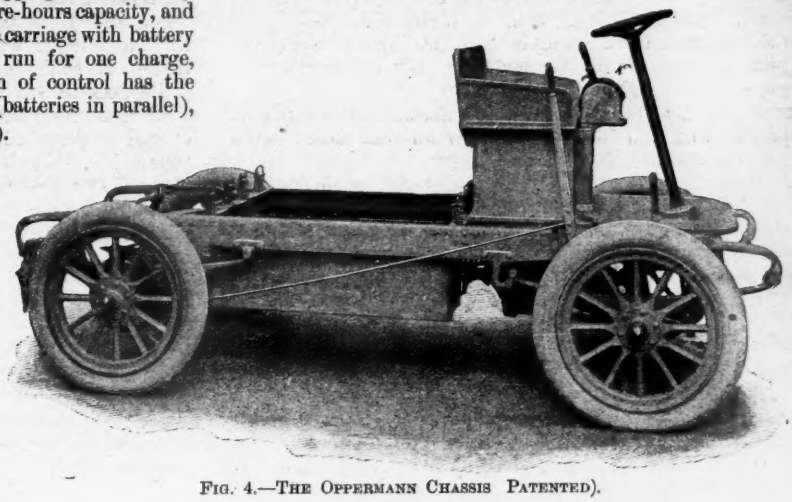

Fig. 4.—The Oppermann Chassis Patented).

## CORRESPONDENCE.

*Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### Slovenly Business Methods.

I should like to call the attention of those of your readers who are connected with manufacturing firms to an oversight which occurs on the part of their clerical staff. For some time past it has been the practise of many firms, when addressing letters and invoices, to address them blankly as ——— Corporation, ———. In my own case, letters and invoices are daily being received addressed in this way. At present there are about one dozen different departments of the Corporation, with offices in various parts of the town, and, consequently, when letters are received addressed like this, they have to filter their way through the various departments, from the town clerk's office, till they reach the right one. This process often occupies a week, and the delay is solely due to the senders. As there are so many firms who permit their letters to be sent out in this way, it would be impossible to write each of them a separate letter, pointing out the inconvenience of such a course.

**Borough Electrical Engineer.**

### Overhead Construction.

With the rest of the world, I was not astonished to find in your issue of November 17th an article which discourages belief in certain statements of fact which I had the honour to submit in a previous issue for the consideration of your readers.

In order to recall my position to the memories of your readers, I may be allowed to quote the sentence which opens that portion of the article to which "A Lineman" takes exception:—"The greatest part of the maintenance of overhead work is directly due to circular wire, just as the life of the rails hitherto has been that of the joints, those points of fatal weakness. Until a perfectly smooth path is provided for the trolley-wheels by the removal of the ear from contact with them, the heavy depreciation of the trolley wires at every point of suspension will continue, and this must be so for so long as ears are soldered directly on to the circular wire. Figure-8 wire would be the salvation of many a line in England, and the difficulties of erection are traditional only."

Now, the proposition of a perfectly smooth path being that which will cause the least possible wear both to itself and to that which moves over it, sounds reasonable enough as a general proposition, and quite apart from tramways, but "Lineman" says that the case of the trolley wheel running over the trolley wire is different, that, in fact, the least wear occurs when the wire is "protected" by a break in its smooth regularity at every point of suspension. Neither he nor anyone else disputes that a mechanical ear cannot be applied to circular wire without enlarging the section of the path of the trolley-wheel, and he says that his experience proves how injurious it is to try to prevent this. For instance, when a deep grooved ear which became "badly worn in corrugated fashion" was replaced by the best type of shallow-grooved soldered ear, the wire under the ear being unprotected by the lips of the deep-grooved ear "rapidly disappeared! Finally, *grooved* wire superseded the circular wire, "and the results are no more satisfactory." "Lineman" ridicules the explanation of all this trouble which his brother lineman gives, as quoted in my article, and puts it all down to the pitching of the cars: "The actual cause of the wear is due neither to 'arcing' nor 'bumping' of the kind suggested by Mr. Tweedy. . . . The trolley pitches with the car, and at the rigid span the trolley wire suffers. . . ."

Let us consider these very positive statements. In the first place, one does not look for the trolley wire to be worn dangerously where it is clasped by a deep-grooved ear, until the lips themselves are worn through, except in the case of "arcing" wear, as explained below, but one does look for wear with considerable certainty where the wire leaves the ear. A bump occurs as the wheel hits the larger section or drops on to the smaller, and an arc may occur at the same instant. Nobody complains that wires break under the ears, but that they snap off at the ends.

The corrugations on the under side of the wire in a deep-grooved ear have met with little or no public mention, but

they provide an interesting subject for study, and for speculation as to their true cause. It was Dudgeon again who brought this phenomenon under my notice, and I am inclined to account for it by assuming that the stiff but springy trolley-pole is set vibrating at the sharp impact of the wheel against the leading end of the ear, and consequently the pressure of the wheel against the wire is caused to fluctuate, so producing crests and hollows in the metal. Probably this happens only with deep-grooved ears, which present a comparatively deep step for the wheel to jump, or with shallow-grooved ears from which the end clips have not been removed either purposely or by wear, and the possibility of the suggestion being correct is heightened by the observation that the amplitude of the waves increases constantly from the end towards the centre of the ear.

A perfectly smooth path for the wheel, such as would be presented by figure-8 wire, does away with the cause and the effect of this bumping wear.

No shallow grooved ear in use to-day was so dimensioned when new that it did not overhang the vertical tangents to the circle of the wire, and it is to that fact that we must look for an explanation of the rapid disappearance of which "Lineman" writes. It is that which brings about the arcing style of wear, so christened by Dudgeon. Directly the trolley wheel meets the lips of the ear it is thrown out of contact with the half circumference of the wire, and has to exchange a comparatively good contact for two points on the flanges. On an up grade, when heavy currents are demanded by the cars, this contact is not sufficient, and destruction of the under surface of the trolley wire follows.

Corroborative evidence is given by the ears on the down-grade of the same hill, for nothing but "bumping" wear occurs there as no current is drawn. On one hill, therefore, the life of the ears on the up-grade may be measured in months, as against years for those on the down wire. An interesting and helpful fact in connection with this is that the clips at the ends of shallow ears disappear by degrees on the up wire of a hill, but remain on the down wire. Arcing removes them in the first case, and finally produces a smooth path for the wheel, but not until the wire has been reduced seriously, while "bumping" without arcing on the down line has little effect on the obstructions, but causes corrugations on the wire itself instead of on the ear, as would be the case if deep grooved ears were used.

Besides circular section wire, we have in England what is called the grooved section, and the true figure-8 section. As you pointed out in that part of your description of the Tramway Exhibition which appeared on August 11th, there is all the difference between these sections when considered with relation to the trolley wheel, and I am quite prepared to believe "Lineman" when he says that the wear under the ears was as bad with grooved wire as with circular wire held by shallow ears. If figure-8 wire had been used this wear would have vanished, for there would have been no projections beyond the section of the lower bulb to impede the smooth path of the wheel.

From what I have said it will be fairly evident that "the cause of the wear is *not* the same on up-hills as on down-hills and levels."

I have just received a letter from Mr. Dudgeon, from which I trust you will allow me to make lengthy extracts, for then anything further from me will be unnecessary, as he deals with the outstanding points in such a practical and careful manner. I should like to say that I was not prepared for his statement that there is no difference between rigid and flexible suspensions, so far as rate of wear of the trolley wire is concerned. With the majority of people who have any opinion at all on the subject, I have held that span-wire suspension is the best; but, in view of the measurements taken by Mr. Dudgeon, I am prepared to modify my views, and shall await with curiosity the results of similar measurements which the present correspondence may stimulate your readers to take. It will surprise many to learn that great differences in the pressure of the trolley wheel against a wire which is truly central to the track have little or no effect either way on the wear of the wire. That is not to say that normal pressures in excess of 18 to 25 lb., according to circumstances, need not be avoided. Probably on those few lines where the trolley wheel has a path of equal section throughout, little notice need be taken of trolley pressure so long as it does not fall below a certain minimum, but wherever there are ears to be bumped, and larger sections every 40 yards to give smaller contact, the pressure should be regulated carefully.

Mr. Dudgeon says, "If anyone cares to put my notes on wear, as incorporated in your article, to the test, it may trouble him to dispute them. 'Lineman' has not, for he says offhand that the trolley wheel makes more contact at the ears than on the free wires. That is precisely what most people would say before they tried it. He does not realise what I meant by 'rigid suspension,' for he goes under a low railway bridge to find an example; but the conditions there are essentially different from those on the road with the trolley pole at the usual tension."

He goes to some trouble to explain about an ear that "fulfils my ideal but was found wanting." "In it you have doubtless recognised the shallow-grooved ear mentioned in your article. The lugs on the ends were not designed to be filed off, as 'Lineman' says, but even if they were, the ear would not fulfil the conditions I laid down, for though it is only sweated on the top half of the wire; the sides are considerably wider, say, ear $\frac{1}{2}$ in., wire $\frac{5}{16}$ in. These sides foul the wheel. . . ."

"The above are the grounds on which 'Lineman' disputes my theory. Now we shall see how his stands when looked into from the top of a tower wagon on a system older than Glasgow, and using different types of cars on different routes where nearly every known style of ear is to be found, where there are bracket arms (rigid and flexible suspensions), span wires, swivel and fixed trolley heads, plenty of hills and very low bridges . . . . . My proof that the rigidity of the trolley wire does not appreciably affect the wear is found in careful measurement with a micrometer. It is necessary to take the measurements on a straight road, for if there is the least curve and the wires are out of alignment with the track another factor comes in, as I explained in my original letter.

Table I.

| Location. | Diameter 4 in. from ear. | Diameter between ears. | Diameter 4 in. from next ear. |
|---|---|---|---|
| Bath Hill, "up" ... | ·308 in. | ·307 in. | ·3085 in. |
| Bath Hill, "down" ... | ·320 in. | ·322 in. | ·320 in. |

"The spans were tight, and there was practically as much rigidity 4 in. from the ears as directly under them, yet the greatest difference is only $\frac{1}{50}$ in. after five years' hard wear."

The following measurements were taken from wires held very rigidly under troughing below a bridge, where the available clearance between wire and rail is 11 ft. 3 in., probably the worst example in England :—

Table II.

Four measurements on one wire, ·322 in., ·320 in., ·318 in., ·318 in.
Same wire at usual height clear of bridge, ·319 in., ·320 in.
Four measurements on other wire under bridge, ·315 in., ·316 in., ·316 in., ·316 in.
Same wire at usual height clear of bridge, ·318 in., ·317 in.
The greatest difference here is only ·003 in. after two or three years' wear.

The wires clear of the bridge are suspended on the bow-string bracket system. Certainly the flexible span is of no great length, but its flexibility must be greater than the suspension under the bridge, which converts the wire into a rigid bar.

"If there was anything in 'Lineman's' theory, then the wire near the ears would show very much more wear, for on one of the above spaces on the up line on Bath Hill, when the ears were changed a year ago, the trolley wire under the ears was found to have arced away until the wire measured ·187 in."

Particular attention should be paid to the difference between the diameter of the up and down wires on that hill (Table I.). The Americans found that wire which transmitted heavy currents to the trolley-wheels diminished more quickly than mere rolling friction would account for. If then the plain wire is reduced in this manner, how much more likely is it that the wire under an ear will be reduced too?

"Then, again, according to 'Lineman,' an ear riding free on the wire between suspensions should show no wear. I have examined a splicing ear in such a position, and find that it is wearing at just the same rate as one 14 yards farther on that has been attached rigidly to a bracket arm for five years. I have examined also a splicing sleeve in the same position, and find that in 15 months $\frac{1}{32}$ in. has been arced off its vertical diameter, while the wire close to it has worn only $\frac{1}{64}$ in. in six years.

"On the —— section, where only bogie cars are used, and where the suspensions are 'rigid,' the ears wear in exactly the same way, and at the same rate as on sections where single-truck cars are used. On —— section, where very heavy bogie cars are used extensively, the wear at the ears is worse on the up line."

I recognise fully that different phenomena are to be expected on different lines, but the general principles will remain fairly constant within wide limits. No one should arrogate the power to prove conclusively any point in argument as affecting all systems when the material of the proof is derived from a comparatively small number of observations made over a comparatively short length of track, and it is for that reason that I hope the evidence of others from all parts of the country will be given, so that true light may shine upon our darkness.

**Robert N. Tweedy.**

Stourbridge, *November 21st*, 1905.

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In the Review a week or two back there was an article on the above subject by "A Lineman," in which he says the wear at the ears is due to the rocking of single bogie cars, and that the cure is double bogie ones.

He takes some pains to make me out a duffer, because my theory of the wear, as explained in a previous article by Mr. Tweedy, does not agree with his. If, as he says, "my remarks are entirely erroneous and I have yet much to learn," I am afraid, to say the least, he would be a bad tutor. His argument is so absurd that I think it is a slur on the intelligence of linemen in general.

I could bring forward heaps of facts that would entirely disprove his assertions, but I think it would be taking up space unnecessarily. Suffice it to say, that I am employed on a system where both double and single bogie cars are used on different sections, and that there is no difference whatever, either in the rate or appearance of the wear at the ears.

He argues with me that the ears on an up-hill wire wear quicker than those on a down-hill one. On some of the hills here the up ears have been renewed several times in the course of seven years; whereas most of those on the down wire side by side on the same span and over the same track as the others, are practically as good as when first put up. "Lineman" gives two reasons for this difference. One is because "the rigidity is greater." Now where, or for why, is the rigidity greater? Will he please explain? In his other reason it is "due to fact that the pitching motion of the car is shorter and more acute and to the consequent retarded movement of the trolley wheel." This rather complex state of affairs, he explains in his previous sentence, is governed by the speed of the cars. At a high rate of speed the effect at the ears is visible, but apparently harmless, "corrugations." As the speed gets slower, as in climbing a hill, things get more acute, and the result is the ears get corrugated to the scrap heap. Therefore, the slower the *cars* go the quicker the *ears* go. This is surely something for every tramway engineer to ponder over. It is horrible to contemplate what must be going on overhead when a car is creeping along through fog or is slowing down to stop. Perhaps the trolley wheel, being so much "retarded," goes round the wrong way, and saves the situation.

With reference to my own theory of the cause of the wear, I would ask "Lineman" to try the experiment described in Mr. Tweedy's article, with trolley wheels, ears and wire.

I would also like to point out to him that neither grooved-wire ears nor the ears he describes for circular wire, offer a free path to the trolley wheel. I am well acquainted with the latter type, having several hundred under my care.

**H. Dudgeon.**

Stourbridge, *December 4th*, 1905.

### A Death Trap.

I beg to give poor nervous "Tin-Tack" a little advice, if he is still in the land of the living, and his fragile anatomy has not been dead-earthed in the meantime through his cruel chief's biting sarcasm, or the H.T. "juice" having broken down his thin-skinned dielectric.

First of all, I should advise him, if possible, to forsake such an awful "death-trap," and take up some less risky occupation, such as measuring calico or baby ribbon. Should he not be able, however, to follow the above course, but be forced by circumstances to stay in his chamber of horrors, I should advise him to have a good protective suit made on the following lines:—The material to consist of two thicknesses of $\frac{1}{2}$-in. pure Para rubber of an insulation resistance of not less than 10,000,000 megohms per cubic millimetre, and capable of withstanding his chief's maximum sarcastic pressure $\times$ 1,000 $\times$ $\pi^2$ for a period of not less than 500 ampere-hours. The space between the two thicknesses to be filled with atmospheric air or senseless vapourings (S.V. "T.-T."), so that, if the volts happen to drop, poor "T.-T." will not get bruised, and also will be guarded from accidental contact with the H.T. bus-bars or such dangerous things as "earthed" transformer and switch-cases, metal door-knobs and the like.

**Tin-Tack Hammer.**

[We do not think that any useful purpose will be served by a continuation of this correspondence.—Eds. E.R.]

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### Christmas Boxes.

The interesting communication from Mr. Walter Davenport, which was published in your issue of last week, is worded in such a peculiar way that one is tempted to ask whether its ingenuousness is intentional or accidental. Are we to understand that a genuine attempt is to be made to abolish the pernicious system of Christmas boxes, or are the members of the N.E.M.A., who framed the resolution, playing with the matter? As it reads, it appear that *applications* for Christmas boxes will be ignored; but I think it is within the knowledge of all that those presents which are sent out in response to applications form a very small percentage of the whole. I merely ask this question because there are strong doubts whether the members of the N.E.M.A. can hang together on a simple matter like this any better than they are doing on the question of local exhibitions—or, indeed, anything else where there is an opportunity of securing an advantage over competitors. No doubt my scepticism will call forth a protest; but I shall be happy to hand you privately the names of any recipients of gifts that come to my knowledge, as well as those of the donors.

**Index.**

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### The Truth about Gas.

The enclosed paragraph appeared in the *Daily Mirror* for Saturday, December 1st. You will see it relates to high pressure gas lighting, and that certain statements (unqualified) are made as to its superiority over arc lighting. What are the real facts of the case?

As a student of electricity I have been trying to obtain really reliable information on this point, but a statement which is made one week by one side is contradicted the next by the other. Have no tests been made by a disinterested authority at any time?

**High Press.**

[The paragraph is headed "Improved High Pressure Gas Lighting at Buckingham Palace." It is well known, however, that Buckingham Palace is lighted with electricity; the gas lamps in question are used only *outside* the Palace. This kind of misrepresentation has been going on for a long time, and is undoubtedly inspired by the gas people.

It is amusing to read that "The brilliant effect of the high pressure gas lighting in the neighbourhood of the arc lamps proves conclusively the immense superiority of gas over electricity for illuminating purposes."

*In the neighbourhood of the arc lamps*—Borrowed plumes!

Why do not the editors of the daily Press, who insert such paragraphs, go and see for themselves whether the statements that they father are true? As for reliable, independent tests of both gas and electricity for street lighting,

those of Mr. Bradley, City Engineer of Westminster, are unimpeachable; and they prove electricity to be the best and cheapest.—Eds. E.R.]

### Belfast Tramway Engines.

In connection with the new Belfast electric tramways we notice that reports have appeared in the Press, which are not only misleading to the public, but very detrimental to our interests, and we now take the opportunity of laying the facts of the case before your readers.

The main point at issue is, the running of the engines non-condensing, and from the specification issued by V. A. H. McCowen, Esq., city electrical engineer, we give you the following extracts:—

Each engine shall be arranged to drive one 1,000-kw. dynamo. It must be capable of giving continuously the required power for its dynamo output, with steam pressure at the stop valve of the engine of 170 lb. per sq. in.

The engines shall be capable of working up to 25 per cent. overload by by-passing steam or other approved means, and the flywheel shall be sufficiently heavy to deal with momentary overloads of 50 per cent.

The engines shall be capable of giving *the above duty when working condensing with a vacuum of 25 in.*

The following tests will be made:—The engine will be run for 12 hours continuously, driving its own dynamo at full power. The engine shall run steadily, quietly, and without knocking or heating, at the specified power and speed. Indicator cards and electrical readings will be taken during the run.

The engine shall also be tested at three-quarter load, half load, quarter load and dynamo excited, for steam consumption, both condensing and non-condensing; governor tests will also be carried out.

The guaranteed results shall be filled in on the attached schedule by the party tendering, and it must be distinctly understood that the figures given as to efficiency, steam consumption and governing are to be guaranteed by the contractor, and shall form part of this contract, and shall be the subject of a test.

The economical operation of the steam dynamos is most important, and the figures guaranteed by parties tendering shall be obtained subject to a bonus or deduction of £250 per engine for every lb. of steam per kw.-hour, and *pro rata* for every one-tenth part of a lb. of steam below or above that guaranteed when the engine is *working full load condensing.*

This will be the subject of a test to be carried out in the presence of, and to the satisfaction of, the engineer.

The only other reference as to how the engines are to run is in the Schedule of Guarantees, where the steam consumption is specified at full load, three-quarter load, half load, and quarter load, condensing and non-condensing. There is no other reference whatever to running the engines non-condensing.

In accordance with the specification, therefore, the engines were designed for most efficient running when working condensing. At the same time, the engines are capable of working up to full load, and have been running with full load and up to 10 per cent. over-load when working non-condensing.

The main contention between ourselves and the city electrical engineer is the length of time the engines should run in this way.

We maintain that we were only called upon to run non-condensing in the case of an emergency, such as the breakdown of the condensing plant. On the other hand, the city electrical engineer states in his report to the Tramways Committee:—"I will find it necessary to run them either condensing or non-condensing for long periods." The reason of this is that he now finds that the condensing plant will not be ready for some months; this is due to the fact that the pump house for the circulating pumps, which is built on the banks of the river, and which is no part of the main contract, is not yet completed.

The engines are completed to carry out the full requirements of the specification, but we maintain that it is not advisable to run them for long periods with the present valve setting. We have pointed out that a slight modification will make them suitable for running non condensing for long periods, but in that case the valve setting would have to be altered before the efficiency could be attained which we have had to guarantee when running condensing.

We may point out that the engines are constructed with an automatic by-pass valve worked by the governor, which admits steam when necessary into the middle pressure cylinder, and are not fitted with automatic expansion valves.

In the face of this, we maintain that the specification has been strictly adhered to, and the reports which have been put out are not only misleading, but are incorrect and detrimental to our interests.

**Fairbairn, Lawson, Combe Barbour, Ltd.**
Branch: Combe Barbour.

London, *December 4th*, 1905.

[In view of this statement, our impression is confirmed that a quite unnecessary fuss is being made. As mentioned in our "Tramway Notes" last week, there appears to be no ground for withholding the complete service of cars until next February—at any rate, so far as the engines are concerned. Is there some other reason, not stated, for the general manager's action?—Eds. E.R.]

### Regenerative Control.

I have no desire to use so much of your valuable ink and paper—that I am writing to you again is Mr. Raworth's fault, not mine.

I have used every means to raise myself out of the Stygian darkness into which Mr. Raworth has consigned me, and have even gone so far as to devour a reprint of the voluminous, but somewhat one-sided, correspondence which has been passing between that gentleman and the publisher of one of your contemporaries. As a result, I regret to report that, like the whale mentioned by Mr. Raworth, I am suffering from indigestion.

I am quite convinced, however, that regenerative control will be the only system used in the next world—only there will be no more self-induction, neither heating nor sparking.

Mr. Raworth asks me to say what facts he has left unpublished, which is exactly what I have been asking him.

I have, however, already ventured to indicate the presence in his system of several sample niggers, whom, however, he does not seem to welcome very warmly.

May I enumerate the chief points with information obtained and comments thereon?

1. *Speed on Hills.*—A shunt motor pounds uphill at full speed, and takes an overload while working at minimum field.

If any confirmation is needed, it is given by Mr. Raworth's own figures of the awful overload forced on his motors by the "shoulder of mutton" hill. Yet this point, curiously enough, is claimed as an advantage by the supporters of the system.

Mr. Raworth himself occupies a good deal of space in the series of love letters referred to, in proving the obvious fact that at a high speed a shunt motor can be made to take more load than a series motor of corresponding winding.

Of course, the series motor is not such a fool as to overload itself while running with weak field, but, like the British workman, the more it has to do, the slower it does it.

Mr. Raworth is triumphant because his motors do not spark under their ill-treatment.

I fully believe that the reason why he has not found himself in a hole yet from this cause, is given by himself in letter No. 7 of the above-mentioned series, where he says that the *horse-power of motors usually fitted is altogether excessive.* At Southport he actually used *one small series motor* in place of the *two* larger motors advised.

2. *Size of Motor.*—This is partly covered by the above.

Mr. Raworth objects to my results, which, he says, are the faults of the designs used.

No doubt the actual figures will vary slightly with the design, but the main relation will hold, as this depends on first principles.

But first principles, like poached eggs, are indigestible when served alone, for which reason I gave them a solid foundation to sit on.

I quite realised that Mr. Raworth overruns his shunt for starting, to get the extra amperes-turns corresponding to those given by a heavy starting current in a series motor. My comparison was at normal load and speed, so that this point does not affect my comparison, which I maintain is quite fair.

The temperature rating is, of course, at full load, for which condition the windings of both motors should be

designed, and in neither motor will the field be saturated, or the extra ampere-turns at starting would be of little use.

The "error" into which Mr. Raworth falls is comparing a satisfactory shunt motor with a series motor, of which he gives no particulars, but which is probably *much too large for its work.*

3. *Self-induction of Shunt.*—This little nigger is shrivelled up by a stroke of the pen.

The self-induction of an extra heavy 500-volt shunt has no more terrors.

This is curious, considering that Mr. Raworth tells us in letter No. 9 of the above-mentioned series that the field is fully excited before the power (armature) circuit is closed.

In conclusion, I may say that I have no animus against shunt control, which I always advocate for suitable cases or against dynamic braking, and which I have used with excellent results for various purposes.

I have no wish to kill Mr. Raworth's goose, which I hope may lay him many a golden egg—but I strongly object to calling it a swan.

**Crane.**

P.S.—Since when have shunt motors been self-exciting?

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### Lead-Covered Wire.

*Re* lead-covered wires, pressure of other matters has prevented me replying sooner to the question asked in your issue of 17th ult. by Mr. S. G. Payne.

He admits the possibility of electrolytic action taking place, but says, "inasmuch as, should this occur, the current will flow from the *iron to the lead*, it does not appear that the lead covering will be damaged by it." The italics are mine.

Now, in this statement, Mr. Payne is right, and at the same time he is wrong, for the current will flow from iron to lead at *the points of actual metallic contact*, but (and it is a most important but) from lead to iron through the electrolyte.

I have never analysed the condensed moisture inside a conduit, but assume that it is most likely to contain sodium chloride and ammonium chloride, and in both of these solutions lead is electro-positive to iron. In dilute $H_2SO_4$, iron is electro-positive to lead, but this is an unlikely electrolyte to find inside an iron pipe laid in the ground.

Mr. Payne cites the example of a prominent firm of cable-makers to disprove my contention. Well, or course, I know such things are done—and done successfully, too, at times—but because a "Blondin" walks half-a-dozen times a day across a tight-rope in mid-air, such a feat does not convince me but that it is safer for the average mortal to walk on *terra-firma.*

And, probably, did we fully know the circumstances, those cable-makers carefully considered all the local conditions before recommending such a method; and can Mr. Payne tell us whether the cables were sheathed with steel wire armouring?

**John D. Mackenzie.**

Glasgow, *December 4th*, 1905.

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### Re L. M. Waterhouse and the Patents Acts.
### Patent No. 28,632 of 1903.

May we add to Messrs. Glynne, Jones & Co.'s letter, that our case against Waterhouse's patent was supported by Messrs. Astbury, K.C., and J. C. Graham as counsel, and Messrs. Dugald Clerk and C. E. Lugard as experts, and found acceptance with so experienced a judge as Mr. Justice Buckley.

**The Metallic Seamless Tube Co., Ltd.**
A. E. Evans, *Secretary.*

Birmingham, *December 5th*, 1905.

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### What is a "Kilo"?

Glancing down the "Situations Wanted" columns of your current number, would that I had a berth to offer 5,271, whose opinion would certainly carry much weight—or does the 3,000 refer to the capacity of the station? If so, what an opportunity for tariff reform; why has no one thought of it before—electrical energy dispensed by the gramme!!

**W. A. B.**

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["Rennet" has omitted to send his name and address,—Eds. E.R.]

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## REVIEWS.

*Accumulatori Elettrici.* By Dr. V. Lucchini. Milan: Editori della Biblioteca di Elettricità. Price, lire 3.

On opening this book one finds that the original work of Volta is mentioned, and the history of accumulators carefully gone into from the earliest experiments in 1800. To record the numerous developments from that date to the present time occupies practically one half of the volume, consisting, with an appendix, of 456 pages.

The historical portion starts with the discovery of Nicholson, in 1800, that water was decomposed by passing electricity through it. In 1801 Gautherot found that a reverse current was established when the poles of his voltameter were reconnected. Erman, of Berlin, and Ritter, of Jena, are also mentioned amongst the early experimenters; to the latter is attributed the honour of christening the apparatus "secondary battery," whilst his researches included the formation of plates of most of the common metals:—gold, silver, platinum, iron, copper, &c. The author, however, reserves to Gaston Planté the merit of being the first to undertake a vigorous research with the object of arriving at a practical result, and deals fully with the more rapid formation process introduced 20 years later by Faure.

In thus picking out a few of the names mentioned in the early part of the book, scant justice is done to the author in the labour that he has undertaken in collecting and recording very fully the early stages of the accumulator.

Whilst following further the developments of the Faure process, one is seriously led to consider whether the present day inventors and designers of motor-car radiators might not profitably study the numerous dodges introduced to improve the surface and weight proportions of the lead plates, of which Dr. Lucchini gives so many examples.

The second part of the book is concerned with the theory of lead accumulators. The reader is, however, left to digest these numerous theories of English, Continental and American scientists for himself, with little aid from the author. A judicial summing up of the separate theories would have made this part of the book more complete.

The third part deals with technical points, being divided under different branches into ten chapters.

In the chapter on "Raw Materials," a table is given showing that a good sample of lead contains only 0·012 per cent. of impurity, made up as follows:—Antimony, 0·004 per cent.; bismuth, 0·004 per cent.; copper, 0·0017 per cent.; silver, 0·0005 per cent.; zinc, 0·0005 per cent.; iron, 0·0009 per cent.; and cadmium, 0·0004 per cent. Other data are given in sufficient detail to enable a very exact specification to be drawn up as to the "precise" class of lead required. Several methods are given by which manufacturers of lead (chiefly German) conduct their refining operations; sulphuric acid is dealt with from manufacture to use; the distillation of water is also considered.

The types of plates are divided into two classes—(*a*) plates with a finely-divided surface (translating literally "nervous" plates), or of the grid pattern, and (*b*) the assembling of strips or wires of soft lead, as in the Blot and other cells. The negative plates are usually made in the same way for either type. The furnaces and presses used in the manufacture of the plates are described and illustrated, as well as the various accessories; also the methods adopted to cause the litharge to adhere to the supports.

The formation of the plates is dealt with in the next chapter, under the sub-headings—Planté process, electro-chemical process and chemical process. The object being to cover the plate evenly with a layer of peroxide of lead, the Planté process is condemned as being very lengthy and costly,

one or other of the alternative methods being now usually adopted, with electrolytes of exact proportions and under a careful system of regulation.

Subsequent chapters deal with the arrangement of plates in the cells; the erection of cells, including a description of the hydrogen and oxyhydrogen flames with their gas generating apparatus for burning together the connections; charging the batteries, dynamos, regulators and automatic switches, but omitting the mention of any system of boosting or automatic regulators; the value of accumulators to an installation, showing how in some cases they may be used in conjunction with a dynamo driven by wind power and giving numerical examples of the correct size of battery to use under various conditions; special applications of accumulators, for driving vehicles, boats, lifting trains, for telegraphic and telephonic work, &c.; the maintenance of accumulators, covering the daily inspection to which they should be subjected during charge and discharge and the proper upkeep of the controlling apparatus.

The appendix deals with the practical application of accumulators in Italy, including a description of the large battery in the central station at Milan capable of supplying 7,000 H.P. for one hour; the result of experiments carried on for a number of years on electric traction with accumulators; methods of analysing sulphuric acid, lead and other materials employed, with the means to be adopted to identify any impurities, and a concluding article on the medicinal prevention and cure of lead poisoning and ill effects of acid fumes, ailments frequently troubling workpeople engaged in the manufacturing processes.

Dr. Lucchini has evidently compiled rather than written the work. That he has taken immense trouble in collecting the material there can be little doubt; there is much to be learned from it by manufacturers as to what their opponents are doing; not only in one particular country, but in all the more important centres.

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*British Progress in Gas Works' Plant and Machinery.* By C. E. Brackenbury. (Vol. III. of "National Engineering and Trade Lectures." Edited by Ben H. Morgan.) London: Archibald Constable & Co. 1905. Price 6s. net.

This volume, of 105 pages, treats the subject of machinery for gas works' plant under the following heads:—

Origin of Gas Lighting, Coal Storing, Retort Houses and Benches, Retort Stoking Machinery, Inclined Retorts, Coke Plants, Condensers, Exhausters, Washer-scrubbers, Purifiers, Station Meters, Gas Holders, Station Governors, Water Gas Plant, Gas Appliances, By-products, and Conclusion and Summary.

To these is added:—A Classified List of British Gas Engineering Literature, (1) Earlier Books and Pamphlets, (2) Later Books and Publications, (3) Students' Books, followed by a Classified List of British Firms Interested in the Manufacture of Gas Works' Plant.

The work contains 113 excellent illustrations, prepared from photographs and drawings.

In dealing with the question of the original discovery, the author is unable to decide between Dutch Minkelers 1784, French Lebon 1786, or British Murdoch 1792, but claims for Britishers the lion's share of credit for the practical application and extension of gas lighting. The lecturer likewise claims that the British gas industry is ever on the watch to improve designs and keep its machinery up to date.

The date of the first gas company—the London and Westminster Chartered Gas Light and Coke Co., is given as 1810, but it was several years later when gas works could receive their coal by rail. In dealing with the receiving of coal, the Hone patent grab, of which the Gas Light and Coke Co., London, has over 100 at its different stations, is said to save 4½d. per ton, or about £66,000 per annum; while unloading by elevators can be effected at about 1¼d. per ton, even in a small plant, and in some cases this cost is reduced to 1d. In regard to retorts, a recent change is shown by an illustration of the first practical setting of vertical retorts, the advantages of which, or otherwise, will only be proved after a lapse of time.

Referring to the different machines for retort-stoking, West's modern combined drawing and charging machine worked by compressed air is quoted as marking a good step forward.

From the inclined retort as suggested by M. Coze, in 1885, there have sprung 160,000 lineal feet of inclined retorts in Great Britain, representing over £1,000,000 in value, while in France, the land of its origin, there are less than 3,000 ft.

Among the many interesting details mentioned is the "Largest Gasholder in the World" at the South Metropolitan Gas Co.'s Works, in which 1,840 tons of wrought-iron, 320 tons of steel and 60 tons of cast-iron were employed, the total cost being £61,000, which works out at the low figure of about £5 per 1,000 cb. ft. of gas storage.

The latest advance, as far as regards lighting appliances, is marked by the high-pressure system, in which it is claimed that the cost of 1,000 C.P. per hour is 1d.

Though the lecture was intended chiefly for those interested in the gas machinery trade, even the man-in-the-street would find much to interest him in a perusal of the condensed information given, while the object of the promoters of the lectures is amply fulfilled by the careful and complete manner in which the subject has been dealt with.

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*The Mechanical Handling of Material.* By G. F. Zimmer. London: Crosby Lockwood & Son. 1905. Price 25s. net.

Mr. Zimmer is a specialist in the construction of appliances for the handling of grain, ore and coal, and the book under review is a compilation of notes taken during the course of his experience. The result is a collection of drawings and data concerning machinery designed to handle material, such as we believe cannot be found elsewhere. In addition to the personal study of Mr. Zimmer, the proceedings of the Institutions of Civil and Mechanical Engineers, the friendly assistance of Lord Armstrong and the late Herr Krupp, besides other sources, have been laid under contribution, so that the book should be representative of modern standard practice. Much of the matter is outside the immediate concern of the station engineer, dealing as it does with appliances for the handling of such diverse goods as corn, beer barrels, molten iron and slaughter-house carcasses. The handling of coal, coke and ash, however, is one of the most exigent problems of the power house, and the information which the book contains on this topic will be found to be of much value.

The book is divided into four main sections:—the continuous handling of material, the intermittent handling of material, loading and unloading devices, and miscellaneous operations and appliances. By far the largest division is the first, and the respective merits of worm, push-plate, band, trough (either continuous or vibratory), or tilting-bucket conveyor may be fitly estimated from these pages. Mr. Zimmer also discusses in this section elevators of various descriptions, coke conveyors and various tightening gears. In the second section rope and chain haulage in connection with light railways and aerial ropeways are discussed, and the electro-technical reader is tempted to stray from his normal course of study by the interesting descriptions and illustrations of coaling at sea by means of aerial cableways.

In the third section we have an admirable array of discharging apparatus—such as skips, grabs and coal tips. The man in charge of the black gang in an electricity works must sigh for some of the machinery that unceremoniously seizes a coal truck by the hinder extremity and compels it to disgorge its contents without loss of time. A very useful chapter on the automatic weighing of material, including descriptions of Avery's, Ingrey's and other makers' weighers, is included in section four, which also contains a chapter of great importance on coal-handling plant for gasworks, power stations, boiler houses, &c. The "Hunt" system appears to us to receive considerable attention, but a very representative collection of other types is also given. The final chapter on cantilever cranes is also worthy of the attention of managers of large coal-consuming plants.

Detailed criticism of such a book is impossible in these pages, as the design of each machine can only be judged by practical results in operation. The construction of such machinery is largely a matter of attempt and experience,

theory only providing a means of attacking the central problems. In giving us this book describing so many successful designs, therefore, Mr. Zimmer has most valuably contributed to the mitigation of the lot of the power house designer, which is usually not a happy one. Indeed, were it not that every conveying plant has to be adapted to local conditions, we should be inclined to think that Mr. Zimmer, by the care and completeness displayed in publishing the results of his and others' experience, had given his occupation away.

## THE FIXATION OF ATMOSPHERIC NITROGEN.

In a recent number of *Le Génie Civil*, M. A. Boileau has published a survey of the methods that have been proposed for converting the nitrogen of the atmosphere into cyanides and nitrates for employment in agriculture and chemical industry generally. Neglecting the processes he describes which are not of an electrical character, we have extracted the following particulars from his article.

*Calcium Cyanamide and Cyanides.*—The German patents controlling the manufacture of calcium cyanamide are held by Drs. Frank and Caro, and are being exploited by a Berlin company, in which Messrs. Siemens & Halske and the Gold und Silber Scheide-Anstalt, of Frankfort, are concerned. The original process consisted in raising powdered barium carbide to redness in a muffle furnace, and passing a current of nitrogen over it. Thirty per cent. of the carbide was thus converted into cyanide, and the rest into cyanamide with separation of carbon, the product containing about 11 per cent. of nitrogen when the original carbide was 80 per cent. pure. On fusing the mass with soda, the cyanamide was converted into cyanide; and on lixiviating the melt a crystallisable solution of sodium cyanide was obtained, together with a precipitate of barium carbonate which was ready for conversion into carbide in an electric furnace. The various operations involved a loss of about 14 per cent. of the nitrogen. The next step consisted in working with calcium instead of barium salts. In this case calcium cyanide was not obtained, but solely the cyanamide; and the latter, unlike the corresponding barium compound, was fit for immediate employment as a fertiliser. A carbide of 75 to 80 per cent. purity was heated in an electric or muffle furnace, and treated with nitrogen, of which it absorbed 85 to 95 per cent. of the theoretical quantity, yielding a black mass containing lime and carbon, and from 20 to 23·5 per cent. of combined nitrogen. The product was next fused with common salt, when it was converted into cyanide, and contained from 90 to 95 per cent. of the nitrogen originally fixed. Erlwein has stated that this process gives a cyanide of 30 per cent. strength without any purification, which is quite fit for gold extraction.

At the present time a more economical method, avoiding the preliminary preparation of any carbide, is used, lime and carbon being heated in presence of nitrogen in an electric resistance furnace. The product is calcium cyanamide as before, and it is now worked up in a variety of ways. On treatment with water the calcium cyanamide is converted into the crystalline dicyanamide (dicyandiamide) containing 66 per cent. of nitrogen. If the latter is fused with sodium carbonate, it is converted into sodium cyanide, some ammonia is given off which can be absorbed in sulphuric acid so as to obtain ammonium sulphate, and a sublimate of polymerised cyanamides is left which can be fused again with a subsequent batch. The sodium cyanide is white, crystalline, and very pure; and its manufacture in this way avoids the inconveniences accompanying the evaporation of an aqueous cyanide liquor. The crude calcium cyanamide contains between 14 and 22 per cent. of nitrogen; the yield is 1,250 kg. per electric H.P.-year. The details given by Boileau as to the employment of calcium cyanamide as a fertiliser have already been published in the Electrical Review. The value of cyanamide (itself), and of dicyanamide as fertilisers have not yet been fully established, according to Boileau; but it should be recollected, he says, that by simple addition of a molecule of water cyanamide yields urea, and, by heating under pressure with water, gives ammonia, like the calcium compound. It is also conceivable that they may prove useful in chemical synthesis—in the preparation of alkaloids and albuminoids, for example. By combination with sarcosine, cyanamide yields creatine, a substance which exists in muscular tissue.

*Nitric Acid and Nitrates.*—Boileau then proceeds to discuss the manufacture of nitric acid and nitrates by submitting air, or air duly enriched with oxygen, to the action of the electric discharge. After referring to early experiments and investigations, he goes on to describe the apparatus employed at Jersey City by the Atmospheric Products Co., who are "operating" Bradley & Lovejoy's patents, and who use a direct current. The apparatus itself consists of a vertical iron cylinder revolving 500 times per minute. Connected to the positive pole of the dynamo through its spindle, this cylinder carries 23 horizontal rings of brass, each ring being fitted with six small metallic projections covered with platinum points. The cylinder revolves inside a case, which is provided with an equal number of projections connected to the negative pole, and insulated in porcelain, except at their ends, where they terminate in depending platinum points. The current is derived from a 45-KW. dynamo, which gives an average current of 0·75 ampere at 8,000 volts, but can be urged till it delivers "several amperes" at 15,000 volts. Thus the current makes 185 (? 138) arcs, the circuit being opened and closed 50 times per second, each arc receiving 0·015 ampere. The total number of arcs is therefore 6,900 per second, and the duration of each is $\frac{1}{20000}$th of a second. The interior of the apparatus is coated with an asphaltum varnish to protect it from corrosion, and it is maintained at a temperature of about 80° C. The air is dried by means of calcium chloride before entering the reaction chamber, and quits it for a coke tower, which is supplied with water or a solution of soda according as acid or salt is required. In the latter case a mixture of nitrite and nitrate is obtained, from which 65 grammes of nitric acid ($HNO_3$) per H.P.-hour can be recovered. The plant in actual operation is said to be of 2,000 H.P.

In the Kowalski and Moscicki process, an alternating current of 0·05 ampere at 50,000 volts is employed in an apparatus resembling the last, but fitted with discharging points of aluminium 20 cm. apart. The yield of nitric acid is stated to be about 53 grammes per KW.-hour, but it can be increased by enriching the air with half its volume of oxygen. An important improvement can also be effected by increasing the electric pressure to three or four times the figure mentioned, multiple electrostatic condensers being employed for that purpose. According to Brandt, 1 KW. will actuate 13 Noé electrostatic machines of six plates each, and, grouped in batteries, these will produce 50 to 58 grammes of nitric acid per hour.

Boileau next describes the apparatus constructed by Birkeland and Eyde, of Christiania, on lines that have already been traversed. He remarks that their process has the economical advantages of permitting the employment of powerful arcs, whereas in those previously discussed the energy of each arc must be reduced as much as possible. A 500-KW. Birkeland apparatus will work for several hundred hours without injury to the discharging points, so that they can be constructed of iron or copper. Moreover, the dimensions of the apparatus are such that it can be cooled with circulating water. The yield of a Birkeland apparatus is 900 kilogrammes of nitric acid per KW.-year. Roeber has proposed a modified system of construction, in which the effective surface is increased by causing the successive arcs to occupy a spherical space instead of a disk.

Boileau sums up his study of the electrical processes for oxidising atmospheric nitrogen as follows:—One of the disadvantages of these processes is that they yield a mixture of nitrites and nitrates, and as the former are harmful to vegetable life, the products are not suitable for agricultural purposes. They might be made so by a complete oxidation of the nitrite, but on a large scale this operation does not work well. An absorption of the vapours by water so as to produce a 55 per cent. nitric acid is practically possible, but the plant would doubtless be too expensive to allow the products to be sold for manures; and, moreover, it is not quite certain that the proportion of nitrites could be sufficiently

reduced. The manufacture of explosives is the second most important application of nitric acid; but that industry requires a very concentrated acid, whereas electrical nitric acid has a strength of 55 per cent. at the highest. Thus it remains to be seen whether a concentration of electrical acid from its original strength to that of 68 per cent.—*i.e.*, to a specific gravity of 1·414—would not destroy the apparent economy of any electrical method of preparation. The electrical manufacture of a fertiliser (calcium cyanamide) and of cyanides fit for employment in industry, on the other hand, is already an acccomplished fact.

As M. Boileau returns the yields of the different processes he describes in different units, it may be convenient to reduce them all to kilogrammes per horse-power-year of 8,760 hours. They then stand thus :—

| Product. | Total kilogrammes. | Kilogrammes of combined N. |
|---|---|---|
| Crude $CaCN_2$ ... ... ... | 1,250 | 175-275 |
| $HNO_3$, Bradley ... ... ... | 569 | 126·5 |
| $HNO_3$, Kowalski ... ... | 327-380 | 73-85 |
| $HNO_3$, Birkeland ... ... | 670 | 149 |

## LEGAL.

In *re* Letters Patent No. 14,006 of 1903, Granted to J. N. Alsop, and the Patents, &c., Acts.

(*Concluded from page* 878.)

At the conclusion of the arguments of Counsel, judgement was reserved.

On Tuesday last week Mr. Justice Buckley postponed the hearing of the petition for revocation, which had been fixed for Wednesday, until after judgement was given in the above appeal.

South-Western Electrical Co., Ltd., *v.* Neale.

In the City of London Court, on Monday, before Judge Lumley Smith, K.C., an action was brought by the plaintiffs, of Palace Terrace, Fulham, to recover the sum of £65 against Mrs. M. J. Neale, Pepys Road, Wimbledon, the price which she had agreed to pay for certain assets of the company. Mr. Romer Macklin appeared for the plaintiffs, and Mr. Clarke Hall for the defendant. The claim was admitted, but the defendant raised a set off of £141 18s. 9d. Mr. Hall said that the defendant's husband was an electrical engineer, and in 1903 he was carrying on business as the South-Western Electrical Co. He sold the business to a company, and he remained managing director of it. The business was not a very flourishing concern, and in December, 1903, the sheriffs came in and the assets of the company had to be sold. On January, 1904, the company went into liquidation, and a Mr. Peebles was appointed liquidator, *pro tem.* Mr. Salomon was afterwards appointed, and he was bringing the present action on behalf of the company. Mr. Neale, the managing director, was made a bankrupt. As Neale was the man who knew most about the company's business, it was desirable to save the goodwill of the concern as far as that could be done, the intention being to float a fresh company out of the ruins of the old. Neale acted partly for the liquidator and partly in managing the business for his wife, who had taken over the business from the liquidator. That was at the premises of the defunct company. That arrangement went on for some time, Neale receiving two guineas a week from his wife. It was then arranged that the liquidator should pay the defendant a guinea a week for the services of her husband in assisting in the winding up of the company. Subsequently, it was arranged that instead of paying Mrs. Neale, the liquidator should set the payments off the £65 which Mrs. Neale had agreed to pay for the business which she bought back from the liquidator. Those payments were now set-off the plaintiff company's claim. Defendant was also setting off other payments. The company had four apprentices, three of whom had paid £30 premium each, and one £40. They had still about three years to run, and it was arranged that, instead of the liquidator paying the apprentices the proportionate amounts due to them at the time the company broke up, Mrs. Neale should take over the apprentices, and that she should be credited off the £65 with the sums the apprentices would otherwise have received from the liquidator. It was obviously a beneficial arrangement for everybody that the apprentices should be continued in the service. Then the defendant had had to pay rates and taxes which she also now desired to set-off the plaintiffs' claim.

Mr. George Neale was called, and he said the arrangements relied upon by him were made with the liquidator's clerk, Speigel. He had lost over £900 by selling the business to a company.

In answer to the set-off, Mr. Salomon said Speigel had no authority to make any arrangement spoken to. He had left his service now. Neale had completed some electric lighting contracts for him, and he had been paid. As for the apprentices, he never agreed to any such suggestion as was now put forth. The apprentices had no claim against him (the liquidator). Their claims for unexpired time might have been proved in the liquidation of the company. It was very doubtful whether they would have got anything, and it was very doubtful whether the creditors would get any dividend at all. Neale had given him some assistance, and if the Court cared to deduct, say, £5, he had no objection. But to raise a set off for £140 was ridiculous.

Judge Lumley Smith said it was quite clear that the claim of the apprentices would be against the company in the liquidation, just the same as any other debt. Neale had given a muddled account of the whole matter. He would allow £7 10s. for the work which Neale did in helping the liquidator, and judgement would be given for the plaintiff company for £65 (less the £7 10s.), and costs.

Turner *v.* Potteries Electric Traction Co.

At Hanley County Court on November 29th, Geo. Turner and his wife, of Longton, sued the Potteries Electric Traction Co., Ltd., for £100 damages sustained through the death of their son, whose death was alleged to have been caused through the negligence and carelessness of the company's servants. The deceased, aged 10½ years, was on June 28th riding on the back of a cart, when he jumped off and was knocked down and killed by a tramcar travelling in the opposite direction. The Judge held that there had been contributory negligence on the part of the boy, and he found for the defendant company.

Holland *v.* Rylands Bros.

At the Liverpool Assizes (Nisi Prius Court) last week, before Mr. Justice Bray and a special jury, Phillip Holland, trading as Winn and Holland, merchants, Montreal, Canada, sued Rylands Bros., Ltd., of Warrington, for breach of contract in respect of a quantity of telephone wire which it was alleged was defectively galvanised. Mr. T. G. Horridge, K.C., and Mr. Keogh (instructed by Messrs. Hill, Dickinson & Co.), were for the plaintiff, and Mr. W. F. Taylor, K.C., and Mr. Greer (instructed by Messrs. Batesons, Warr & Wimshurst) represented defendants. Defendants denied the alleged breach of contract. The hearing occupied four days.

From a report in the *Liverpool Post and Mercury* it appears that plaintiffs contracted for defendants to supply them with 150 tons of telephone wire to meet an order of the Bell Telephone Co., of Canada. When the first instalment of the wire arrived at Montreal plaintiffs said it was not properly galvanised, and was not according to description or of merchantable quality. The wire was, therefore, rejected. Expert evidence was adduced to support plaintiff's contention that the wire was not satisfactory according to tests they claimed they were entitled to apply.

Mr. W. F. Taylor, K.C., for the defendants, said what the plaintiff was insisting upon as against the vendor in England was the right to damages specifically on the ground that he, by his contract, had a right to reject the wire as not being equal to the agreement. To give him such a right it ought, as a matter of business, to be made clear between the parties to the contract that there was some condition which the vendors had to fulfil, so that they might clearly understand what it was. The case for the defendants was that there was no such contract between the two parties as put upon the defendants the obligation that the wire was to pass tests which had been insisted upon by the plaintiff. Messrs. Rylands were never put under the obligation, and never undertook the burden of sending the wire to pass particular tests which had been referred to. The galvanising was not imperfect, and the wire was perfectly fit in the sense that it was good for the purpose to which the contract related.

Considerable evidence was given to show that the wire was properly galvanised.

His Lordship submitted to the jury the following five questions of fact upon which they were to find:—(1) Did the plaintiffs make known to the defendants the particular purpose for which the wire was required so as to show that they relied on the defendants' skill and judgement? (2) Was the wire reasonably fit for such purpose (*a*) at the time it was loaded on board the barges at Warrington, and (*b*) at the time it was loaded on the ss. *Dominion* at Liverpool? (3) Was the wire of merchantable quality? (4) Was the wire of a quality equal to that which had been supplied by the defendants to the Bell Telephone Co in and before 1895 as "extra best wire." (5) Were the coils substantially defective—he meant in accordance with the contract—owing to their consisting of more than one piece of wire?

The jury retired to consider their verdict.

When the Court adjourned on Friday night the jury, after two hours' deliberation, had failed to find unanimously upon five questions which had been submitted to them by the judge. Three out of the five questions had been answered in favour of the plaintiffs, whilst one had not been answered at all.

On Saturday, according to the *Liverpool Daily Courier*, Mr. Horridge, K.C., for the plaintiffs, said he was quite content with the jury's findings as they stood, and upon them he asked for judgement for his clients.

Mr. Taylor, K.C., for the defendants, said he had no comment to make.

His Lordship then gave judgement for the plaintiffs.

## BUSINESS NOTES.

**Sawing Machines.**—Messrs. Edward G. Herbert, Ltd., of Manchester, have in hand for the Admiralty three full-automatic circular sawing machines for cutting brass and copper bars and tubes up to 3 in. diameter. These machines feed the bar forward, and make successive cuts automatically. Other orders from the Admiralty include a "Git" sawing machine for gun-metal castings, and two No. 3 eccentric sawing machines for cutting steel bars, &c., up to 20 in. × 12 in. Messrs. Herbert have also received a repeat order for an eccentric saw for the Ordnance Department, Woolwich Arsenal, and have in hand one of these machines with independent motor drive for the London County Council Tramways. Several illustrated lists of various sawing machines have been issued by the firm.

**Belgium.**—The last order for insulated rubber cables for the State Railway of Belgium was given to Messrs. Johnson and Phillips, Ltd., through Mr. Douglas Wells, M.I.E.E., of Brussels.

**Cowans's Contracts.**—The following orders have been recently received by Messrs. Cowans, Ltd., of Salford:—

Admiralty.—Main switchgear for dynamos and circuits for H.M.S. *Eritannia*, *Hibernia*, *Warrior*, *Africa* and *Cressy*.
Greenock.—Feeder switchboard.
Great Western Railway (per Electric Construction Co., Ltd.).—Thirteen sets alternating-current Andrews's discriminating apparatus.
Admiralty.—Main switchgear for new battleship H.M.S. *Dreadnought*. The reverse-current devices are to be Andrews's patent "Manchester" type direct-acting circuit breakers.
Bournemouth.—Equipment of three additional alternating-current generators with Andrews's patent discriminating cut-outs of the inductive balance type previously supplied.

**Warning to Contractors.**—Complaints have been made that the following fraud has been lately perpetrated. A gentlemanly man called on a firm of builders and, after having asked them for particulars for a large job, asked them to recommend a firm of electrical contractors, and induced them to write down the name on their own letter paper as an introduction. Armed with this he called on the contractor and, after having made arrangements for a meeting at his country house, discovered that he had left his purse behind, and as his bank was some distance off, "could he borrow a pound or two until the date of meeting?" The money having passed, no more is heard, and on writing to the address given the letter is returned through the Dead Letter Office. If any of our readers have already been victimised, or if such a caller should turn up, please ring up the office of the Association and the hon. sec. will give full particulars. We understand there is also a consulting engineer going round with bogus specifications and forged orders, and getting money on loan to be repaid when he obtains his fees. The hon. sec. can give full particulars of this also.—*The Electrical Contractor*.

**Japanese Cotton Mills.**—Special Agent Crist, of the United States Bureau of Manufactures, in a report published by the Department of Commerce and Labour, says, according to the *Electrical World and Engineer*: "In view of the past favour which the output of Japanese cotton mills has met both here and in China, there is a strong tendency to turn to England to obtain the equipment for the enlargement and modernising of the cotton-weaving industry. This should be a fine opportunity for American manufacturers of spinning, weaving and power machinery to obtain a large share of this if they will send out expert men able to thoroughly demonstrate the economy, efficiency and simplicity of their machines. The situation is being closely watched by American importing houses having branches in New York, and there is a strong belief that steam turbo-generators, which are looked upon with high favour by the Japanese, with electric motors adapted to running looms or spindles in numbers of eight or ten, will meet with success. The engineer of the American Trading Co. informs me he is making a close study of this question, and that manufacturers of steam turbo-generators, motors or dynamos can obtain full information in regard to this matter by corresponding with the New York office of that company. I am also informed that this particular matter is being closely watched by representatives of English and German concerns."

**A New German-Austrian Combination.**—A scheme is being promoted which will have the effect, on completion, of reducing from three to two the number of large firms engaged in the electrical engineering trade in Austria-Hungary. The first group is the Austrian Siemens-Schuckert Works Co. which was formed a year or two ago, while the second relates to the projected establishment of a community of interests between the Austrian Union Electricity Co., which is closely associated with the Allgemeine Co., of Berlin, and the firm of Ganz & Co., of Buda-Pesth. It is understood that negotiations on the subject have been proceeding between the two companies for some time past, and representatives of the Allgemeine Co. have also participated in the deliberations. The scheme proposes the complete severance of the electrical engineering department of Ganz & Co., and its transformation into an independent company. The majority of the shares in the new concern will be held by Ganz & Co., while either all or a portion of the remainder of the shares will be taken over by those interested in the Union Co. On the other hand, the firm of Ganz & Co., or the Hungarian Credit Bank, will acquire a block of shares in the Union Co. In addition to these financial interchanges, the scheme provides for the division of markets between the Union Co. and the new (Union-Ganz) company, and the mutual utilisation of experience and new inventions.

**A City Electrical Exhibition.**—The Charing Cross, West End and City Electricity Supply Co., Ltd., has recently opened a permanent exhibition at 85, Fenchurch Street, E.C., for practically demonstrating the uses to which electricity may be put. The exhibition room has an area of over 5,400 sq. ft., and shows electric motors, driving machines of many types as used in London, also electric cooking and heating apparatus, starting devices, photographic and other arc lamps, Nernst and tantalum lamps, &c. The exhibition is open daily from 10.30 to 4 p.m. This should be a useful means of educating and persuading possible consumers.

**Milan International Exhibition Commission.**—A meeting of the British Commission for this Exhibition was held at the offices of the Commission, Oxford Court, Cannon Street, E.C., on 30th ult., when Sir Albert K. Rollit, M.P., President, was in the chair. The Commission discussed certain points which had arisen in regard to restriction on the admission of British goods intended to be shown in the Working Hall of Industrial Arts and the Decorative Arts Section of the Exhibition, and instructed the hon. Executive Commissioner to proceed to Milan to interview the Exhibition authorities there, with the object of discussing necessary modifications in the interpretation of the regulations by the Italian authorities. A number of gentlemen were elected on the Commission, including the Rt. Hon. the Earl of Glasgow, G.C.M.G., &c., Sir Philip Watts (the Admiralty), Sir Alexander Binnie, Sir Thomas Wardle (Leek), and representatives of the Manchester Society of Engineers, the Iron and Steel Institute and the British Chamber of Commerce for Italy (Genoa). The Commission appointed "Executive" and "Juries" Committees, and approved the Finance Committee previously formed. Arrangements were made for the representation of the Commission in Milan. The Hon. Executive Commissioner made a general report as to the number of exhibitors already enrolled, and a resolution, passed by the Leeds Chamber of Commerce on November 28th, stating:—"That the question of participation is worthy of consideration by the manufacturers of Leeds and district," was read; also communications from the Sheffield, Blackburn, Wolverhampton, Birmingham and other Chambers of Commerce.

**Books Received.**—"Machine Tools." By Thos. R. Shaw. Manchester: Scientific Publishing Co. 15s. net.

"Report of the Locomotive Committee on Standard Locomotives for Indian Railways." Engineering Standards Committee's Report, No. 5. Second issue. London: Crosby Lockwood & Son or the E.S. Committee. 10s. 6d. net.

"Engineering Mathematics Simply Explained." By H. H. Harrison. London: Percival Marshall & Co. 1s. 6d. net.

"Report of the Board of Education for 1904-5." London: Wyman & Sons. 4½d.

"Alternating Currents: Their Theory, Generation and Transformation." By Alfred Hay, D.Sc. London: Harper Bros. 6s. net.

"The Practical Telephone Handbook and Guide to the Telephone Exchange." By J. Poole. Third edition. London: Whittaker & Co. 6s. net.

"Fire Tests with Floors: A Cement Concrete Floor with Bays of Various Aggregates." Red book, No. 101. London: British Fire Prevention Committee. 2s. 6d.

"Proceedings of the American Institute of Electrical Engineers." Vol. 24, No. 11, November, 1905. New York: The Institute, 95, Liberty Street.

"American Society of Civil Engineers' Proceedings." November, 1905, Vol. 31, No. 9. New York: The Society, 220, West 57th Street.

"*Siam Engineering*: The Journal of the Engineering Society of Siam," Vol. 1, No. 1, October, 1905. Publishing Office: Bangkok.

**Catalogues and Lists.**—Messrs. Evered & Co., Ltd., Surrey Works, Smethwick.—Several pamphlets illustrating their various types of switches, switch panels, &c., for mining use. No. 6 briefly describes and prices a watertight switch enclosed in cast-iron case with hinged lid and interlocking arrangement. This switch is claimed to be entirely gas proof, its current carrying parts are of hard drawn copper of ample section, and we understand that it conforms in every detail to the latest American Fire Insurance rules; No. 9 deals with mining panels; No. 5 describes double-pole switches in teak cases; No. 3 is devoted to "A" type quick-break switches, and No. 1 to Barnand's patent protected type quick-break switches.

Messrs. Ferranti, Ltd., Hollinwood.—Catalogue No 52 giving prices and particulars of triple-pole single-throw quick-break knife switches for from 25 to 1,000 amperes.

Messrs. Mavor & Coulson, Glasgow.—The firm's December calendar card gives data relating to a month's cutting by a Pick-Quick electric coal-cutter at a Stirlingshire colliery.

The General Electric Co., Ltd., London.—New booklet giving illustrations and particulars of "Angold" arc lamps. Reductions of prices of lamps and accessories are shown. A new pattern twin carbon "Angold" lamp for continuous current is described. Another G.E.C. list is an abbreviated price card, just being issued, giving particulars of "Witton" continuous-current motors.

The Simplex Steel Conduit Co., Ltd., London, W.C.—Green show-card No. 112, giving a list of contracts for which their material was used during the first eight months of this year. These include 26 cotton spinning mills in this country and abroad, and many hospitals, workhouses, harbour works, collieries, public schools and colleges, town halls, chemical works, electricity works and factories. A large trade-mark show-card (21 in. × 15 in.) is also being issued to customers who require it for display purposes.

Electrical Trades Supply Co., Ltd., Birmingham.—Leaflet S 27 on double-pole switches in cast-iron cases. Also illustrated

catalogue and price list of "E.T.S." incandescent electric lamps for high and low voltages, in all shapes, ordinary tubular, candle, reflector and battery.

Messrs. Hodgson, Wright & Wood, Century Works, Halifax.—Price list of single, two and three-phase motors of squirrel cage and slip-ring types.

Electric and Ordnance Accessories Co., Ltd., Birmingham.—Small pocket pamphlet entitled "System in Business," detailing the "Stellite" central battery exchange system telephone equipment.

British Thomson-Houston Co., Ltd., Rugby.—Several new pamphlets as follows:—No. 185, describing the B.T.H. flexible ear for grooved trolley wire, already shown in our pages; No. 186, describing various portable electrical measuring instruments; No. 187, particularising ammeters, voltmeters and wattmeters for switchboard use; and No. 188, dealing with miscellaneous switchboard instruments. All of the lists are, as usual, well illustrated, and are intended for filing with previously issued circulars of the B.T.H. series.

Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E.—New list of their latest ignition cell price list. We understand that this type of cell is being supplied in large numbers to the trade and motor-car builders at the present time. A stock of all sizes is kept.

C. W. Hunt Co., U.S.A.—Catalogue of "Hunt" steam hoisting engines.

Messrs. Guest, Keen & Nettlefolds, Ltd., Birmingham.—Lists showing increases in discounts on iron and brass screws, &c.

Messrs. Neville Bros., 7 and 9, James Street, Liverpool.—Catalogue (56 pp.) dealing with labour-saving machines and tools for electrical engineers and others. The contents include illustrated descriptions of vacuum drying and impregnating chambers for dynamo and motor armatures, &c., automatic coil-winding machines, slot broaching and slitting machines, automatic tissue papering machines, armature disk varnishing machines, notching and dividing machines, geared rotary shears, dynamo-makers' presses, electricians' hydraulic presses, drilling and tapping machines, portable workshop cranes, "Raffard" flexible safety couplings, regenerative gas muffle furnaces and various other special and interesting lines.

Messrs. Chas. Winn & Co., St. Thomas Works, Granville Street, Birmingham.—New catalogue D. 38 (72 pp., fully illustrated, art paper) devoted to Winn's boiler and engine fittings. Views of the works appear at the beginning of the book, and descriptions of a large variety of steam valves, cocks, lubricators, water gauges, pressure gauges, injectors and other fittings are given, together with particulars of prices. Special attention may be drawn to the firm's improved parallel slide stop valves, in which are employed, in combination with other parts, a pair of wedges and a spring. The latter is fitted in a casing in the usual manner, and two hollow rectangular wedges are hung loosely upon the casing, one on either side of the main spindle. The wedges, we understand, in no way interfere with the free opening and closing of the valve, as they only come into operation when the bore of the valve is closed, and operate upon the valve gates in such a manner as to ensure the valve closing tightly without overstrain, entirely obviating the objectionable tendency to jam or lock, which valves of this type are frequently liable to when operated. The freedom of action and certainty of working thus attained are claimed to constitute important improvements which are much appreciated by users. Attention may also be directed to the asbestos-packed automatic water gauges and protectors illustrated in the catalogue, and the special advantages claimed for these fittings as indicated by the drawings and letterpress in the catalogue. Messrs. Winn have had many years' experience as makers of "Reliable" fittings, and their productions are extensively used by electric power companies, railway companies and other authorities.

Messrs. Mackenzie & Moncur, Ltd., Edinburgh.—A new edition of their catalogue of latest designs of arc lamp pillars, carriers, brackets, &c., has been issued. The size of page (11½ in. × 17½ in.) has allowed the designs to be shown on a large scale, bringing out to advantage the artistic ornamentation. The variety includes many examples of pillars and brackets which have been supplied for street lighting in London and the provinces. Engineers who are engaged upon street lighting questions would do well to keep a copy of this edition before them. Messrs. Mackenzie and Moncur have also issued an illustrated price list of switch blocks, junction boxes, draw-in boxes, and a set of circulars relating to their ventilating road box and pavement covers and frames.

Gilbert Arc Lamp Co.—New and greatly amplified catalogue and descriptive list, giving particulars of all the Gilbert specialities. It is really more than a catalogue—rather a guide to arc lighting, as it contains reprints of articles on actual installations, and notes on globes, cut-outs, series A.C. arc lighting, resistances, post gear, &c., which, quite apart from the apparatus actually dealt with, are of interest and value. Special features of the brochure are the Gilbert moving-coil choking coils, which can be used instead of constant current transformers when the voltage is suitable; the Gilbert flame arc lamps; enclosed arc lamps; "small watt" lamps; enclosed lamps with rod feed; raising and lowering gear, and post gear, the latter assembled ready for fixing; transformers of various kinds, and lamp carriers. The apparatus are made in two grades—standard (high-class) and ordinary—and the lamps are characterised by specially long hours of burning.

Messrs. D. Hulett & Co., Ltd., 55-56, High Holborn, London, W.C.—Catalogue (68 pp.) of electric light fittings, bell fittings, accessories, &c. A large variety of details such as ceiling roses, fuses, cut-outs, switches, lampholders, wall plugs, and ball fittings, are illustrated and priced, as are also steel conduits, tubes and fittings, electroliers, brackets, ceiling, and other fittings, arc lamps, heating and ventilating apparatus, bells and bell accessories, batteries, wires and telephones.

Mr. Percy Pitman, Bosbury, Ledbury.—Illustrated circulars describing his combined "Hector" water-motor and dynamo for charging accumulators, and his tangential water wheel with adjustable nozzle.

The British Prometheus Co., Ltd., Kingston-on-Thames.—New catalogue of electric heaters describing and illustrating altogether some 56 different patterns of convectors, light radiators, and a combined convector and radiator. Many antique-finish copper convectors are illustrated, but the firm also supplies convectors in polished brass or antique brass at the same prices. Full particulars appear of the Prometheus principle, together with working instructions and notes on cost of working. Prices, dimensions and heating capacity are stated in tabulated form.

**The Whitchurch Asylum Installation Contract.**—In a report on the electric lighting of the Whitchurch Asylum, to the Corporation Asylum Committee, Mr. Ellis, electrical engineer, said that Messrs. D. Firth & Son, of Manchester, when tendering for electrically equipping the institution, on June 13th, quoted exactly the specification with all specified materials and fittings, and were cognisant of all the requirements. The *South Wales Daily News* abstracts the report thus:—"It was now 10 weeks practically since the work was begun, and up to now very little progress had been made. There were 3,604 lights to be wired, but up to date they had not completed a single light. It was because he could not see his way to give them a certificate for £1,012 out of a total contract of £6,421 that trouble had arisen. The contractors said that they had understood [? misunderstood] the specification, and could not carry out the work in accordance with the same at the price quoted. The real fact was that the contractors wanted the Committee to finance them during the progress of the work. The report proceeded to state that Mr. Firth had seen him (Mr. Ellis), and expressed a wish to be relieved of his contract, and in a letter to this effect there was a paragraph saying that at the very outset Messrs. Firth were not anxious to secure the contract, and they tendered at such a figure as they thought would exempt them from their offer being accepted. He suggested that another firm be called in to complete the work. The next two lowest tenders received were Lea & Warren (Kettering), £6,491, and Clay Bros. & Co. (Cardiff), £6,964." It was resolved that notice be given forthwith to the contractors requiring that the work be proceeded with in a reasonable manner and with reasonable dispatch, and that failing compliance within seven days a further notice to determine the contract be given; further, that notice be given to the sureties of the steps taken and contemplated by the Corporation, and that in the event of the contract being determined the same be relet to Messrs. Lea & Warren, or failing them to Messrs. Clay Brothers & Co.

**Dissolutions and Liquidations.**—The Electrical Ore Finding Co., Ltd.—A petition presented by Andrew Anderson, mining engineer, a creditor, for the winding up of this company, is to be heard in London on December 12th.

L. Hermes & Co. (electrical engineers and contractors, 29, Uxbridge Road, Ealing, and Acton).—Messrs. L. Hermes and W. A. Wallis have dissolved partnership. Mr. W. A. Wallis attends to debts.

Pioneer Power Co. of London, Ltd.—A meeting is to be held on January 3rd at 58, Coleman Street, E.C., to hear an account of the winding up from the liquidator, Mr. F. W. Pixley.

British Pioneer Electric Light and Power Co. of India, Ltd.—The company on November 2nd and 23rd resolved upon voluntary liquidation.

W. G. Leather (Windus Electric Co.), electrical engineer, Sheffield.—First meeting to be held on December 13th, and public examination on January 11th, both at Sheffield.

**Bennis Stoker Contracts.**—We are informed that the following orders have been placed with Messrs. Ed. Bennis & Co., Ltd., of Little Hulton, Bolton:—

The Wimbledon U.D.C., for its electric lighting station.—A repeat order for four stokers and compressed air furnaces for their water-tube boilers.

The Swadlincote (Derby) U.D.C.—For two stokers and compressed air furnaces.

The Rugby U.D.C., for its electric power station.—Two sets of stokers and natural draught furnaces for Babcock & Wilcox boilers.

Messrs. Clarke, Chapman & Co., Ltd., Gateshead-on-Tyne.—One set of "Bennis and Miller-Bennett" chain-grates.

The Patent Shaft and Axletree Co., Ltd., Wednesbury (Staffs.).—46 stokers and compressed air furnaces, with complete coal and ash-handling plant, for their various works at Wednesbury.

The Babbington Coal Co., Ltd., Nottingham.—Repeat order for six stokers and compressed air furnaces, making a total of 23 supplied to this firm.

**Annual Dinner.**—The Apparatus Department of Messrs. Siemens Bros. & Co., Ltd., held their annual dinner last Saturday week at the Trafalgar Hotel, Greenwich. Mr. O. Doerner occupied the chair, the number present being nearly 120.

**Bankruptcy Proceedings.** — James Wood Smith (Smith & Co.), electrical engineer and contractor, Darwen. Receiving order made November 28th on debtor's own petition.

**Consular Notes.**—Spain.—The French Vice-Consul at Cadiz reports that an electric tramway is now under construction and will be completed in a few months to join the town of Cadiz with that of San Fernando and "La Compagnie Belge," which obtained the concession, proposes to extend the line to Chiclana. Should the undertaking, as anticipated, be very successful, the company will probably extend the line to Algeciras; at present the journey between Cadiz and Algeciras has to be made by coach, and takes 16 hours for a distance of 74 miles.

Uganda.—Lieut.-Col. Hayes Sadler, in a recent report to the Colonial Office on the trade, &c., of Uganda, states that there is one

main line of telegraph connecting the East Africa system with Jinja, Kampala, Entebbe, Hoima and Wadelai, on the Nile. From Hoima a branch connects with Butiaba—the landing-place on the Lake Albert. This year an extension will be carried from Fajao, on the Victoria Nile, through Fatiko to Nimule, eventually, it is to be hoped, to connect with the Soudan system at Gondokoro, which will give an alternate and cheaper line to Europe, besides adding an important link to the Cape-to-Cairo system. During 1904-5 the extension from Masindi to Wadelai was completed, and the work of making permanent the temporary line from Karanias to Jinja was commenced, and subsequently finished. Telegraphic communication was fairly well maintained, and there were fewer interruptions than in the previous year. The Government offices at Entebbe are connected by telephone, and there is a telephone service open to the public on payment, along the Protectorate telegraph wires. £7,440 is the estimated share paid by Uganda towards postal and telegraph expenditure, including £1,747 for new telegraph construction.

**For Sale.**—The Derby borough electrical engineer is offering some arc lighting sets for sale. See our advertisement pages to-day.

**Hello!**—Messrs. Veritys, Ltd., ask us to announce that, for the convenience of their customers, in order, as far as possible, to avoid the prevailing congestion of the National Telephone Co.'s Gerrard Exchange, they have put in a Post Office telephone, the number being 9984 Central.

**Trade Announcements.**—Owing to greatly increased business, Messrs. Bruce Peebles & Co., Ltd., have transferred their London office from Westminster to No. 1, London Wall Buildings, E.C., which will be the headquarters of Mr. Roland S. Portheim, managing director, with Mr. Morton Beales as manager, and Mr. W. J. W. Bullock as chief engineer of the contract department. All communications, therefore, should be addressed to No. 1, London Wall Buildings, E.C., instead of 25, Victoria Street, E.C.

Messrs. L. E. Wilson & Co. have commenced business as telephone experts and engineers at 20, Cross Street, Manchester. Mr. L. E. Wilson was formerly chief electrician of the National Telephone Co. in the Manchester district, where he gained wide and varied experience.

Messrs. C. A. Parsons & Co. announce that owing to the development of their business in Wales, they have arranged for permanent representation there, and have opened an office at Caledonian Chambers, 102, St. Mary Street, Cardiff.

The Maschinenfabrik Oerlikon announce that they have appointed Mr. G. Wuthrich manager of their British, Irish and Colonial department and London resident engineer. Mr. Wüthrich, who was formerly at 19, Barclay Road, London, has been London resident engineer for the company for some time past. From December 1st his address will be Oswaldestre House, Norfolk Street, Strand, London, W.C., and his telegraphic address is "Oerlik London."

Owing to the expiration of lease, Messrs. Roger Dawson, Ltd., electrical engineers, of 8, Berners Street, London, W., are closing their branch at 81, Victoria Road, Surbiton.

Messrs. E. H. Cadiot & Co., 12, Rue St. Georges, Paris, have accepted the sole agency for the Metallic Seamless Tube Co., Ltd., for France and Colonies, and they keep a large stock of metallic tubes and fittings in Paris; the Continental agent of the company is Mr. Douglas Wells, M.I.E.E., 10 Rue de la Pépinière, Brussels.

Nernst Electric Light, Ltd.—From 11th inst., the offices are transferred from 82, Victoria Street, S.W., to 5, London Wall Buildings.

Mr. Fabius Henrion, of Nancy, announces that Mr. D. McNaughton, 79, Mark Lane, E.C., who has for nine years been sole representative for the sale of his carbons, &c., in the United Kingdom, is retiring from the business. Messrs. Geipel and Lange, of 72A, St. Thomas's Street, London, S.E., will represent him in future, and they have engaged the services of Mr. A. C. Ashworth, who was manager of Mr. McNaughton's carbon department, to act in the same capacity for them.

In our last issue we referred to a circular letter issued on the 27th ult. by Mr. N. C. Woodfin, of the firm of Helps, Woodfin and Co. We subsequently received a communication from Mr. J. W. Helps stating that not only was the circular incorrect, but that it came as a great surprise to him, and that he is instituting proceedings against Mr. Woodfin in consequence. We understand that Messrs. Helps & Woodfin have since parted.

## LIGHTING AND POWER NOTES.

**Australia.**—Sydney.—In order to cope with the demand for electric light, the Sydney City Council has decided to invite tenders for increasing the machinery in the power house at Pyrmont by 2,000 kw.; this will bring the total up to 5,240 kw., or, approximately, 9,000 h.p. The extra power will be used for providing light for private consumers. The lighting of a portion of Hyde Park is being expedited; nearly 100 electric arc lamps are to be installed, and when practicable, the lamps are to be suspended from the trees. The statement of expenditure, laid before the Electric Lighting Committee on October 9th, contains the following sentences:—"A loan of £250,000 was authorised, and of this amount £225,000 was raised. The whole of the latter amount has already been used up, while the expenditure and commitments in excess of the amount raised are £19,606, the total expenditure being £244,606, which only leaves £5,394 of the quarter of a million authorised."

**Blackpool.**—The T.C. has decided to apply to the L.G.B. for a loan of £4,000 for E.L. cable extensions.

**Canada.**—The Canadian Westinghouse Co. will shortly commence to install a number of motors, transformers, and other electrical appliances in the grain elevator of the Grand Trunk Railway at Windmill Point, Montreal. There will be twenty motors ranging from 3 h.p. to 200 h.p. distributed throughout the works.

**Cheltenham.**—The T.C. has fixed meter rents for motor supply at £1 per annum up to 5 kw., and £1 10s. per annum for motors of 5 kw. and upwards.

**Colne.**—The T.C. has reduced the rents of electric meters by 50 per cent.

**Continental Notes.**—Italy.—Some few months ago a company of 700 shareholders—all local men—subscribed the sum of £20,000 to establish electric generating works at Bari. The installation will be inaugurated during the present month; it consists of three gas engines each of 250 h.p. by Tosi, operating with low-quality gas; these drive direct-current generators, which, like the boosters, are manufactured by Savigliano; and a battery of accumulators by the Tudor Co. The network is supplied at 2 × 240 volts.

The Municipal Authority of Rome is considering a report from its sub-committee for obtaining the service of water power amounting to about 20,000 h.p., to be used for electrical purposes, situated across an arc of the Neva, between Montoro and Orte, and again near Subiacco. The report states that the cost of the necessary works for utilisation and transmission of the energy would not exceed £20 per electrical h.p., so that energy could be sold in Rome at about £2 per h.p. per annum, a figure which would include a large sum for depreciation and reserve.

Mr. Antonio Vandano has requested permission to take 1,200 litres of water per second, from the River Stresa in the Province of Usiglia; this will provide 5,588 h.p. The electrical energy generated will be transmitted to the Province of Turin for metallurgical works there.—*L'Elettricista.*

The following estimates have been prepared in connection with the contemplated works whereby about 8,000 e.h.p. will be available for distribution in Turin (for convenience the figures are put into English value on an exchange basis of £1 = 25 lire):—

| | |
|---|---|
| Hydraulic works .. .. .. .. .. .. .. | £102,800 |
| Turbines and electrical machinery .. .. .. .. | 41,500 |
| Two overhead lines—Chiomonte to Turin .. .. .. | 39,600 |
| Distributing station in Turin .. .. .. .. .. | 34,600 |
| Distributing network in Turin .. .. .. .. .. | 128,000 |
| Purchase of concession of water-power .. .. .. | 13,200 |
| Total .. .. .. | £359,700 |

With figures such as these, which are likely to be exceeded in carrying out the work, the installation demands the serious attention of manufacturers.

It is proposed to put down a water power plant on the River Corchiano at Corchiano to supply electrical energy for lighting and power purposes.

Germany.—A municipal electricity works is to be erected at Werneuchen.

**Coventry.**—The T.C. has been recommended by a special committee not to make any alteration in the present scale of charges for electricity.

**Dorking.**—A correspondent states that the U.D.C. has sealed an agreement with Edmundson's, Ltd., transferring to them all the Council's powers with regard to the E.L. undertaking, excepting the power of borrowing money.

**Dudley.**—The Corporation Lighting Committee has recommended the T.C. to reduce the price of energy on the flat rate from 5d. to 4d. per unit, and to charge a time switch rent of 2s. per quarter for all future switches connected.

**Dunfermline.**—Conferences have been held recently with representatives of the Fife Electric Power Co., the National Gas Engine Co. and Messrs. Tangyes, Ltd., in regard to the electric lighting question, and it is expected that the matter will be brought before the T.C. at an early date.

**Edinburgh.**—The E.L. Committee, with the conveners of the various Committees, paid a visit to Glasgow recently for the purpose of inspecting the condensing plant at Port Dundas station. The inspection was made with a view to satisfying the Edinburgh Corporation as to the practicability and value of the schemes for providing condensing plant at Dewar Place and M'Donald Road electric power stations.

**Fareham.**—The B. of G. has decided to have the E.L. installed at the workhouse.

**Friern Barnet.**—The U.D.C. prov. order expires on the 31st inst., and the proposals of the North Metropolitan Electric Power Supply Co. have been rejected. A conference has been held with representatives of the Hornsey B.C. with a view to obtaining a supply, but the B.C.'s price has been rejected as prohibitive. The B. of T. has asked for definite information by the first week in January, and a special sub-committee has been formed.

**Gloucester.**—The T.C. has decided to reduce the charges for energy for power purposes as follows:—First 200 units per quarter, 2d. per unit; next 1,000, 1½d.; next 10,000, 1¼d.; all beyond 11,200, 1½d. For energy for the tramways, 1d. per unit is to be charged.

**Hapton.**—The lighting question is at present agitating the township, and deputations from the Burnley Corporation and Padiham U.D.C. have expressed their willingness to supply gas. At a recent Council meeting, a letter was read from the present lighting contractors, stating that providing there was a sufficient demand they were prepared to put down a special plant for the supply of electricity for lighting purposes, and would undertake to supply energy to any householder at 5 per cent. less price than was charged in the neighbouring borough of Burnley; the matter is to be decided at a ratepayers' meeting.

**India.**—Mussoorie.—In regard to the proposed electrical undertaking for this district, *Indian Engineering* states that 20 tenders have been received, that of the Brush Co. being the lowest.

**Kidderminster.**—With regard to the prov. order for E.L. being applied for by the Kidderminster and District Electrical Co., the company has informed the R.D.C. that it intends to extend the mains from Kidderminster, and to supply energy at 4½d. per unit, on the flat rate.

**Liverpool.**—The Mersey Docks and Harbour Board has decided to install six electric jib cranes, and six electric transporters are to be erected at the new No. 1 and No. 2 King's Docks. Tenders have been accepted from the Glasgow Electric Crane and Hoist Co. for the transporters and from Royce & Co. for the roof cranes.

Extensions to the generating and destructor station in Smithdown Road, at an estimated cost of £2,950, are contemplated.

**Liversedge.**—The U.D.C. has decided, in response to appeals by the ratepayers, to withdraw from its agreement with the Yorkshire Electric Power Co., and has resolved to apply for an extension of its prov. order for 12 months.

**London.**—City.—It has been resolved on a recommendation of the Streets Committee to extend the lighting of Lower Thames Street and Monument Street by a larger use in the district of high pressure gas lamps. Considerable discussion on this subject ensued at the meeting, and it was pointed out that the electrical engineer of the Corporation had stated that if the electric lighting company was permitted to install up-to-date apparatus, the gas companies could not compete.

Hammersmith.—It was stated at a recent T.C. meeting that there were many complaints about the quality of the light in the streets and private houses. The electrical engineer stated that the Council only undertook to supply electricity, and not light; the pressure was quite sufficient and, if anything, above that required. The fault lay with consumers in not using their lamps properly.

Marylebone.—The Electric Supply Committee of the B.C. reported on Tuesday having under consideration the purchase of (*a*) a ninth turbine (to be supplied by Messrs. Parsons), £10,000; (*b*) storage battery, North Street sub-station, £10,000; (*c*) storage battery, Rathbone Place sub-station, £5,000; (*d*) two boilers, £9,000. The turbo and boiler plant is necessary to ensure a sufficient reserve in the event of the failure of one of the present large turbines. The expenditure in respect of the storage batteries at North Street and Rathbone Place will be covered by the £15,000 which (under the provisions of the order of the Court, August 7th, 1903) the Metropolitan Electric Supply Co., Ltd., has to repay to the Council in respect of the nine motor-generators at North Street, which the company is now arranging to take back. The additional battery power at North Street is necessary to ensure a continuity of service to Hertford House and the Rathbone Place battery will ensure the Council being in a position to take over the supply of the whole of the consumers in the borough by the end of March next.

Bermondsey.—As a result of further correspondence between the B.C. and the London Electric Supply Corporation in regard to a bulk supply from the latter, the B.C. has intimated its desire to drop the matter.

Hampstead.—The B.C. has decided to revise the charges for private lighting as follows:—Maximum demand system: two winter quarters, 6d. per B.T.U. for 182 hours' consumption of maximum demand per quarter, and 1½d. per unit beyond; two summer quarters, at a uniform rate of 1½d. per unit. Flat rate system: a uniform rate of 4d. per unit.

Shoreditch.—The B.C. has decided to supply energy for heating purposes at 1d. per unit, as from the end of the present month. The Lighting Committee of the B.C., in a recent report, gives its opinion on the Administrative Power Co.'s proposals, and states that "the company seeks to sell at a loss for four years to capture the business, paying dividends meanwhile out of capital." The promoters of the Additional Electric Power Supply (London) Bill (the St. Neots scheme), the Committee states, wish to supply municipal authorities in bulk by agreement, and seek no powers to compete with such authorities, but desire to co-operate for mutual advantage. The Committee has been negotiating with the promoters, and states that the price and terms upon which the new company is prepared to give a bulk supply to this Council (at certain periods of the day), if required, are very favourable to the Council, and are recommended by the borough electrical engineer, but the Committee thinks, for obvious reasons, that they should only be fully considered by the Council in committee. One of the conditions of the agreement is that the Electric Power Supply (London) Bill should be supported by the Shoreditch B.C., which the Committee thinks will be the best means of combatting and defeating the dangerous monopoly sought by the Administrative Bill. The Committee recommended: (*a*) That an agreement be entered into with the promoters of the Additional Electric Supply (London) Bill, and the contract, when ready, be sealed; and (*b*) that the Bills of the Administrative County of London and District Electric Supply Co., and the Charing Cross, West End and City Electric Supply Co. be opposed. The recommendation was carried, as was also another to the effect that Hackney B.C. be informed that Shoreditch would support its Bill if Hackney agrees to support the Bill promoted by Shoreditch.

**Malton.**—Dissatisfaction has been expressed as to the lighting of the town; an inspection of the lamps is being made by the U.D.C., and the expenses in connection therewith are to be charged to the Supply Co.

**South Africa.**—Cape Town.—The city electrical engineer, in a report to his Committee, points out that the cost of production during the year 1904 was 8·21d. per unit, whilst for the nine months ending September 30th, 1905, the cost was reduced to 6·578d. per unit. The revenue from the sale of energy to private consumers up to September 30th of the current year, amounted to £39,974, which on 1,110,498 units sold gives an average price obtained of 8·2d. per unit, this result being obtained with a charge per unit of from 1s. to 8d. for night supply and half this for day energy, equivalent to an average price of 10·516d. and 5·258d. for night and day supply respectively. The electrical engineer suggested that the price to be charged for next year might be fixed on a sliding scale between 10d. and 8d. for night, and half the amount for day, giving an average all-round price of 7·19d. per unit; also that a further reduction might be made for continuous motive power to be used in the daytime only, and suggested the flat rate of 3d. per unit, such rate not to apply to lift motors, and that the energy supplied at such a rate would be cut off by means of a time switch at 6 p.m., and put on again at 12 o'clock midnight.

**Stockton.**—The Council's E.L. prov. order has been extended for another 12 months.

**Stourbridge.**—The T.C. has resolved to apply to the B. of T. for a further extension of its prov. order, and has instructed the Electric Powers Committee to negotiate a sale (with the option of re-purchase) or lease of the order.

**Sunderland.**—A report has been submitted by the engineer, which recommends extensions to the Hylton Road power station, comprising four new boilers and other plant, at an estimated cost of £16,000.

**Sutton.**—The U.D.C. has received two tenders for the public lighting of the streets; viz, from the Sutton Gas Co. and the South Metropolitan Electric Traction and Lighting Co. It was resolved to accept the tender of the Electric Lighting Co. at £757 per annum for five years.

**Todmorden.**—The T.C. has reduced the price of energy for any purpose other than lighting to 2d per unit.

**Torquay.**—The L.G.B. has consented to the Corporation taking up a loan of £8,099 for extensions of the Beacon Quay station, disallowing £1,400 of the total sum asked. In a letter from the Board, read at the Council's last meeting, the former states the desirability of postponing for the present any extension of the system of public lighting on the ground that it is unremunerative, and having in view the financial advantage of utilising the present station as long as possible, intimates that it is clearly inadvisable to increase the existing loan for any unprofitable purpose. Moreover, as the provision of a new station will ultimately be necessary, the undertaking must be carried on with the greatest economy, and in such a manner that a reserve fund may be built up to meet the anticipated large expenditure.

**Warrington.**—The Corporation Electricity and Tramways Committee has adopted the following new scale of charges for energy for power purposes:—40 per cent. load factor, 1d. per unit; 50 per cent., ·98d.; 60 per cent., ·94d.; 70 per cent., ·82d.; 80 per cent., ·76d.; 90 per cent., ·70d.

**Wednesbury.**—The result of the past year's working of the electricity undertaking shows a loss equal to a 1d. rate. No sum has been set aside to depreciation.

**West Ham.**—The price of energy for tramway purposes has been fixed by the Council at 1·6d. per unit for the year ended March last, 1·5d. for the half-year ended September, 1905, and 1d. per unit on and after October 1st, 1905. The Council has transferred the supervision of the overhead equipment from the borough electrical engineer to the tramways manager.

## TRAMWAY AND RAILWAY NOTES.

**Argentina.**—All the tramways of Cordoba have been purchased by a syndicate and are to be electrified. Other concessions have been asked for, for the construction of additional lines to the suburbs. The Buenos Ayres Port and City Tramway Co. has been formed to take over the concession granted to Gandulfo & Co. to build and work an electric tramway from Barrancas Bridge along the Riachuelo and port to Retiro Station, a distance of seven miles.

**Australia.**—The views of the three Victorian Railway Commissioners (Messrs. T. Tait, W. Fitzpatrick and C. Hudson) on the proposed electrification of the suburban metropolitan steam railway service have been laid before the Railway Standing Committee appointed to inquire into the question. The evidence of Mr. Bradford, electrical expert to the Government, was recently given, and the statement by the Commissioners traversed the opinions he expressed. The Commissioners were not opposed to the electrification of the existing lines, provided these would yield sufficient additional net revenue to pay the interest charges and the other costs of revenue. They drew attention to the fact that within the next two years £7,000,000 of State loans would be due for redemption or conversion, and that during that period money would be wanted for other railway works. The system of electrification recommended by Mr. Bradford was that most generally employed at the present time, but it might become obsolete before being completed. The Commissioners dealt with each of the six proposals for tramway lines by Mr. Bradford, and stated that they did not consider any of the six should be built at the present time. They further added:—"The question as to whether the provision of street tramways should not be left to the municipalities concerned, or under satisfactory terms, and with proper safeguards, to private enterprise is one deserving of serious consideration."

**Belfast.**—As already intimated, the new electrical tramway system was successfully inaugurated on the 29th ult. over the southern portion of the lines. The B. of T. inspection of the remaining part of the system is being carried out, and it is expected that the eastern and northern roads will be opened this week. So far everything has gone without a hitch. On the opening day one car, driven by the Lord Mayor, Sir Daniel Dixon, attained a speed of 20 miles per hour. A lady, unconscious of the identity of the titled motorman, "tipped" him with a £1 note, which Sir Daniel accepted and handed over to the Coal Fund.

**Continental Notes.**—Italy.—The Bologna horse tramways have during the last few months given way to a system of electric tramways under the care of the Thomson-Houston Co. The total length is about 17 miles. Inside the city rails of 87 lb. per yard, and outside the city of 60 lb. per yard, have been used, with Falk bonds throughout. The generating machinery consists of three steam sets, each of 225-kw. direct-coupled compound tandem type; the dynamos are shunt-wound, and work in parallel with a large battery of accumulators, 300 cells of 350 ampere-hour capacity. Provision is made for adding further plates, so that the capacity may be increased to 500 ampere-hours if desired; 55 cars have been delivered, of which 48 are in general use, and seven are kept in reserve.

Although electric railway schemes proceed slowly in Italy, an attempt is now being made to induce the Government to display greater activity in the matter by the laying of schemes before Parliament. For instance, the Chambers of Commerce of Lecco and Bergamo have addressed a request to the Ministry of Public Works asking that the conversion of the Milan-Lecco and Lecco-Bergamo railway sections to electric traction should be proceeded with as rapidly as possible. The two electric lines leaving Lecco have hitherto scarcely had any influence upon the traffic results, as direct connection with Milan did not exist, and the train service has only been slightly increased. At Bergamo a committee has been formed with the object of promoting the construction of a high-speed electric railway between that town and Milan. The distance between the two towns by rail is considerably increased by the roundabout way which has to be traversed *vid* Treviglio. A high-speed line is also suggested between Milan and Genoa by a committee which has been formed at the former town under the auspices of well-known men, and with the support of the Italian Commercial Bank, while a further project relates to a main line between Novara and Biella.

**Crewe.**—The L. and N.W. Railway Co. are concentrating their electrical staff at Crewe; the electrical and telegraph staff at Stockport, to the number of several hundred, will move there this week. When the alterations now in progress are completed, Crewe will be one of the best electrically-equipped stations in the world.

**Edinburgh.**—The Tramway Sub-committee last week discussed the present position of tramway matters in the city. Mr. Brown, the representative of the Kingsland electric system, was present, and explained very fully the particular points of that system. The Committee considered that the system was worthy of serious consideration, and an effort is to be made to secure the consent of the lessees of the present tramways to allow the Morrison Street route to be used experimentally for the Kingsland system. The expense is to be borne entirely by the Kingsland Co. The Committee further agreed to ask Sir Alexander Kennedy for his detailed report on the different systems mentioned by him in the Tramway Committee's report, especially with regard to the Kingsland method of traction.

**Lancaster.**—The Corporation last week was informed of the offer of Messrs. Kershaw, of Birmingham, on behalf of a syndicate to purchase the Lancaster horse tramway to Morecambe and electrify it, providing the Corporation will not exercise purchasing powers for 42 years instead of in 1910. The energy would be purchased from the Corporation, which had previously been in negotiation with the company but declined to give more than £27,000 when £30,00) was asked. The Tramways Committee has given Messrs. Kershaw a chance of submitting alternative proposals.

**London.**—London County Council.—The Finance Committee at Tuesday's meeting of the Council reported that the balance of the tramways renewals reserve fund amounted, with accumulations, to £83,041, of which £66,787 had been invested in 3 per cent. county stock. As a request had been made that a further investment should be undertaken of the balance available, the Committee recommended that it should be authorised to invest in a similar manner the sum of £16,200 standing to the credit of the tramways renewals reserve fund. Mr. E. Collins remarked that in other towns 6 per cent. was set aside for depreciation, but the County Council only made provision for less than 2 per cent. The recommendation was agreed to, and it was resolved to sanction the borrowing of £820 by the Woolwich B.C. for the erection of a cooling tower, and to lend £7,500 to the same Council for boilers and extension of mains.

Metropolitan District Railway.—On Monday the last of the steam locomotives on this railway was replaced by electric locomotives, hauling the L. and N.W. trains from Earl's Court, and thus the electrical operation of the underground railways was completed, and the way left clear to carry out the acceleration of the circle traffic. The maximum speed, however, will not be attainable until the reorganisation of the signalling apparatus is complete.

**Mexico.**—La Electrica Co., of Guadalajara, Mexico, has decided to erect a large steel and masonry building there at a cost of about £60,000. It will be 354 ft. long and 169 ft. wide. A modern car repair shop and a transformer station are included in the plans.

**West Bromwich.**—In a report issued last week, the Highways Committee of the Corporation stated that the matters in dispute with the South Staffordshire Tramways (Lessee) Co. had been settled as follows: The company had paid certain arrears due from them for electrical energy supplied. The use of the Quin cut-out was to be discontinued, and instead the company was to adopt the most approved method in existence; the rent payable under the lease was not to be reduced by the discontinuance of the Quin cut-out system, and the company was to bear the whole of the costs in connection with the alterations; the company was to be allowed to run smaller cars. The company agreed to take a minimum supply of electrical energy of 900,000 units per annum, instead of the minimum of 300,000 per annum provided in the lease; but at the prices fixed by the lease.

## TELEGRAPH AND TELEPHONE NOTES.

**Durban (S.A.)**—The Postmaster-General of Natal has written to the T.C. with regard to the establishment of communication between the Durban Municipal Telephone Exchange and the Trunk telephone system of the colony. It was hoped in the course of two or three weeks to have the line between Durban and Pietermaritzburg completed, and later on to connect it with Ladysmith, Dundee, and Newcastle; but until some agreement has been arranged the service lines between the Municipal Exchange and the Government Exchange could only be used by local subscribers through the call office. He suggested the payment of a maximum sum of £200 a year by the Council, to place local subscribers on equal terms with Government subscribers. Negotiations have been going on for some time, and it is also hoped eventually to have communication with Johannesburg.

**Persian Telegraphs.**—The Central Persian telegraph line is, says *Indian Engineering*, to be extended from Bam to Karachi this cool season.

**Wireless Telegraphy.**—Trinidad.—The Governor of Trinidad, in a recent report to the Colonial Office, states that the electrical engineer of the Colony has been carrying out experiments in wireless telegraphy during the year 1904-5. A receiving and transmitting station was erected at Port-of-Spain (Trinidad), and endeavours were first made to obtain direct communication with a station erected at Scarborough (Tobago), across the intervening lofty northern range of wooded hills in Trinidad. Communication was obtained, but not sufficiently distinct to justify the belief that a satisfactory system could be established direct between the two places. A temporary experiment station was, therefore, erected at the lighthouse at Chacachacare, and between this point and Tobago—a distance of 68½ miles, with no land intervening; communication proved easy and reliable. The Port-of-Spain station has now been transferred to the North Post Signal Station, a spot on the north-west coast, about 9 miles from Port-of-Spain, and connected by telephone with the capital, and as soon as the installation is completed, it is hoped that a regular and satisfactory system of communication will be opened to public use between Trinidad and Tobago.

Italy.—A commission has been appointed by the Postal Authorities in Italy to consider the application of the wireless telegraph service to private uses.

**Tramway Supper.**—The Bury tramway employés were entertained to supper at midnight on Tuesday last week by the Tramways Committee.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Australia.**—December 18th and 19th. The Deputy Postmaster-General, Brisbane, invites tenders for the supply of insulators, phosphor bronze wire, copper sleeves, binders and tapes.

The Deputy Postmaster-General, Melbourne, invites tenders for the supply of (1) 10 miles of 26-pair lead-covered paper-insulated telephone cable; (2) 1 mile of 156-pair lead-covered paper-insulated telephone cable (12½ lb. conductors); (3) 5,000 barrel insulators, delivery within three months of date of acceptance of tender.

**Austria.**—December 20th. The Austrian State Railway authorities at Pilsen are inviting tenders until December 20th, for the establishment of an electric lighting plant at the railway station in that town.

**Bermondsey.**—December 8th. Water-tube boiler, and 500-KW. steam dynamo for the B.C. See "Official Notices" November 24th.

**Brazil.**—December 16th. The municipal authorities of Sao Luiz (Maranhao), Brazil, are inviting tenders until December 16th, for the electric lighting of the town.

NICHTEROY (Rio de Janeiro).—Installing a system of electric lighting.

**Buxton.**—December 15th. One 52-KW. gas-driven balancer set for the U.D.C. See "Official Notices" December 1st.

**Clyde Navigation.**—December 18th. Crane, electrically driven capstans, and tipping turntables. See "Official Notices" November 24th.

**Dublin.**—December 11th. Electric lighting of the new Fire Brigade Station, Great Brunswick Street, for the Corporation Waterworks Committee. Specifications, plans, &c., from the City Treasurer, Municipal Buildings, Cork Hill (£2 returnable).

**London.**—December 11th. The Powell Duffryn Steam Coal Co., Ltd., invite tenders for the supply of the undermentioned stores, &c., from January 1st, 1906, including india-rubber and asbestos goods, and electrical fittings. Forms of tender, Stores Manager, Aberaman Offices, near Aberdare.

**Plymouth.**—December 23rd. Coal discharging and conveying apparatus for the Corporation electricity department. See "Official Notices" to-day.

**Poplar.**—December 13th. Steam engines, dynamos, pipework, switchboard, wiring, motors, fire alarms, telephones and electric bells for the Guardians. See "Official Notices" November 17th.

**Spain.**—January 30th. The Spanish Ministry of Public Works in Madrid, is inviting tenders until January 30th for the concession for the construction and working of an electric tramway between Santander and Astillero. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Obras Publicas, Madrid.

**Stalybridge Joint Board.**—December 18th. Advertising rights on 55 electric cars. See "Official Notices" December 1st.

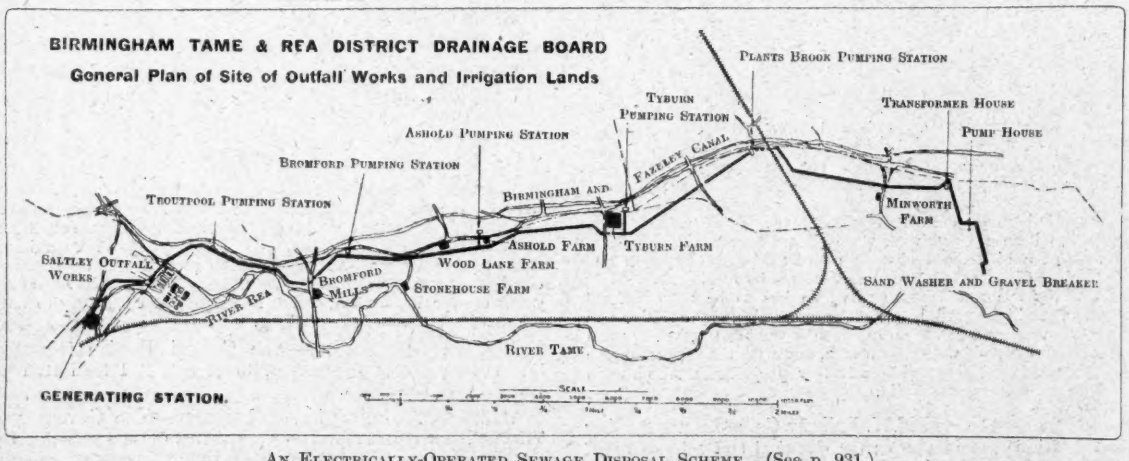
**Swindon.**—December 19th. Three double-deck radial-axle truck tramcars for the Corporation. See "Official Notices" December 1st.

### CLOSED.

**Barrow.**—In connection with the proposed extensions, the T.C. has accepted the following tenders:—

| | |
|---|---|
| Vickers, Sons and Maxim .. .. .. | £2,864 |
| Babcock & Wilcox .. .. .. .. .. | 1,228 |
| Phœnix Dynamo Co. .. .. .. .. | 247 |
| James Hodgkinson, Ltd. .. .. .. .. | 210 |
| Hitchen and Sons .. .. .. .. | 392 |
| Herbert Morris and Bastert, Ltd. .. .. | 261 |

**Bedford.**—The Borough Education Committee has appointed Messrs. Wilson Bros. to do electrical engineering work during the ensuing half year.




AN ELECTRICALLY-OPERATED SEWAGE DISPOSAL SCHEME. (See p. 931.)

**Dublin.**—December 11th. The Corporation Lighting Committee want tenders for the electric lighting and ventilating of Green Street Court House. Specification at the Office of the City Electrical Engineer, Fleet Street, Dublin (one guinea).

**France.**—The Prefectural authorities of La Loire Inferieure, at Nantes, are about to invite tenders for the supply of the plant required for the electric lighting of the entrance to the port of Saint Nazaire.

**Grimsby.**—January 5th. 500-KW. engine and dynamo, boiler, switchboard, and other plant and cables for Corporation electricity department. See "Official Notices" to-day.

**Ilford.**—December 12th. Triple-concentric armoured cable for the U.D.C. See "Official Notices" November 24th.

**Islington.**—January 1st. Suggestions for purification of water are invited by the B.C. electricity department. See "Official Notices" to-day.

**Launceston (Tas.).**—January 15th. 500 or more electric meters; maximum demand indicators; for the Corporation. See "Official Notices" November 17th.

**Cardiff.**—The Asylum Committee of the City Council on Monday considered tenders for the electric installations at the new Asylum. The tenders of the Electric Power Storage Co. to supply the batteries, for £956; Messrs. Siemens Bros. & Co. for engines and generators, for £11,998; and that of the General Electric Co. for a switchboard, for £527, were accepted.

**Carlisle.**—The tender of Mr. C. E. Vormeister, for the E.L. installation at the new Palace Theatre of Varieties, Carlisle, has been accepted.

**Clydebank.**—The Works Committee of Clyde Navigation Trustees have recommended for acceptance the offer by Messrs. Wm. Shaw & Sons, Ltd., for the power station buildings at Clydebank Dock, subject to the engineer's approval of the sub-contractors.

**Durban.**—Ten tenders for new cars were recently submitted and the Committee recommended the acceptance of that of the British Westinghouse Co., the cars to be fitted with No. 220 motor equipment and a new and improved type of magnetic brakes.

**Salford.**—The contract for fibre conduit placed with the Key Engineering Co., Ltd. (see ELECTRICAL REVIEW, last week, p. 884), was for 13,000 yds., not 6,000.

(Continued on page 935.)

# AN ELECTRICALLY-OPERATED SEWAGE DISPOSAL SCHEME.

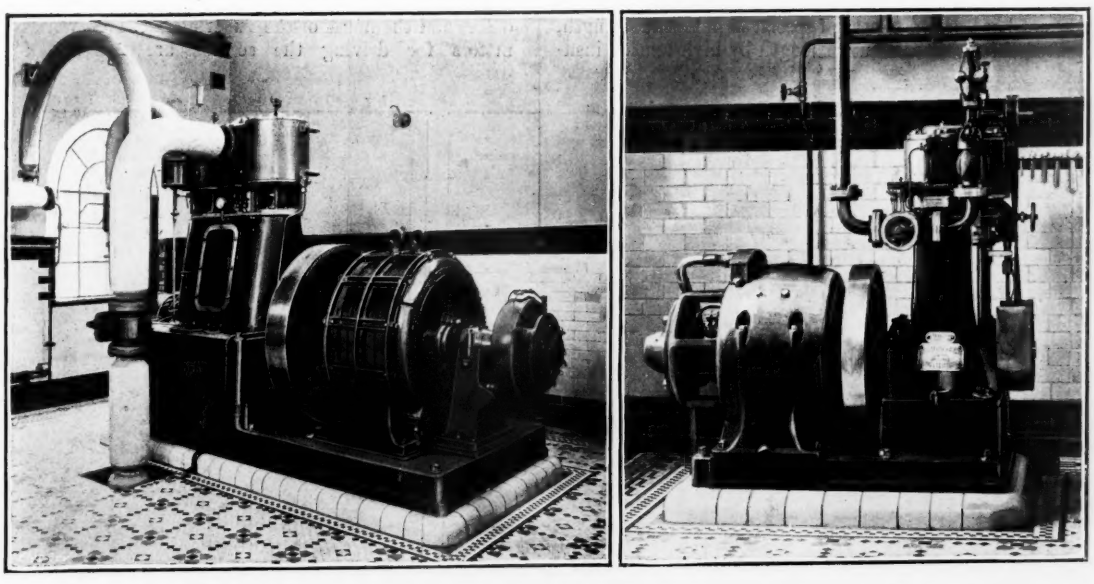
An electrical power transmission scheme, extending from Birmingham down the valley of the Tame for a distance of about 6 miles, has recently been completed for the Birmingham, Tame and Rea District Drainage Board, for the purpose of enabling the latter to pump sewage up to a strip of land situated at a higher level than the main conduit which conveys the sewage from the outfall works to the sewage farm, in the Tame Valley. The scheme is due to the enterprise and initiative of the engineer to the Board, Mr. John D. Watson, M.I.C.E., and has been carried out in its entirety by the British Thomson-Houston Co., of Rugby.

Fig. 1—The Saltley Destructor and Generating Station, Showing the Overhead Transmission Line.

The Drainage Board's estate comprises a total area of 2,830 acres, used mainly for irrigation.

Apart from pumping sewage, the power transmission scheme is employed to drive sewage screening rakes, sludge elevators, sewage distributors, workshop appliances, farmyard machinery, and for lighting, &c.

The scheme involved the erection of a destructor by the City of Birmingham on land belonging to the Board, a generating station and five brick pumping stations with provision for a sub-station in each, 5 miles of overhead line with underground crossings under public roads, together with the complete equipment of machinery. The generating station is situated near the Saltley boundary of the Drainage Board's estate. It contains two B.T.H. 115-kw. standard three-phase generators (fig. 2), each of which is coupled to a high-speed Belliss & Morcom engine. The generators are designed to give their output at 2,250 volts 50 periods, each being fitted with a direct-connected exciter so that the unit is self-contained. A small continuous-current steam set of 15 kw., 220 volts (fig. 3), also installed in this station, is used to operate a number of B.T.H. enclosed arc lamps on the sewage beds at Saltley: to light the station, and, in case of necessity, to excite the alternating-current generators. The steam is supplied to the engines from Lancashire boilers combined with the destructor which adjoins the generating station, under an arrangement with the authorities of the City of Birmingham.



Figs. 2 and 3.—View of Alternating and Direct-Current Generators, Installed at Saltley.

The engine room and boiler house are lighted from the

generating station, and there are two alternative systems of lighting, one from the continuous current side, and one from the alternating system of supply from the main generators; in the latter case suitable transformers are provided in a transformer chamber under the generating station to reduce the pressure from the primary 2,250 volts to 220 volts, which is the pressure of the lighting circuits.

The main switchboard, which is illustrated in fig. 4, contains two generator panels, for controlling the alternators, the equipment including the main switch, which is of the B.T.H. Co.'s well-known "Oilbreak" type, ammeter and voltmeter, together with the field rheostat for varying the excitation of the alternator. There is also one feeder panel controlling the supply to the overhead line, and to the station power and lighting transformers and one meter panel for measuring the output.

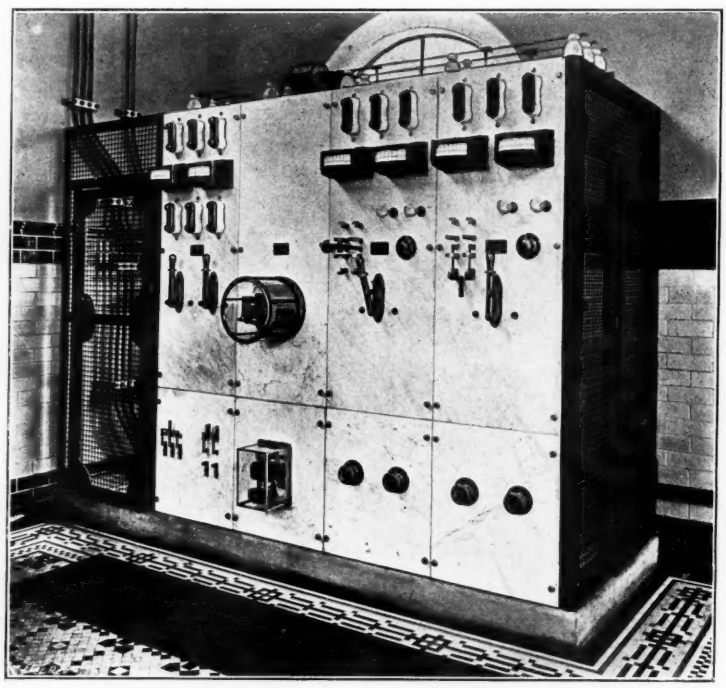


Fig. 4.—Main Switchboard: Saltley Generating Station.

The bus-bars are connected to the overhead line by means of three high-tension cables, separately supported from the walls of the generating station by heavy porcelain insulators, and led up to the outlet which consists of three separate porcelain outlet tubes built into the wall. Through these tubes the high-tension insulated cables are led, and connected outside on shackle insulators to the overhead line, which consists of hard-drawn copper of special high tensile strength, supported throughout its entire length by high-tension insulators of the triple-shed type. The section of the copper in the overhead line is so graded that a drop in pressure of only 7½ per cent. over the whole line is obtained at maximum load. Throughout the length of the overhead line a barbed wire is run on the top of the poles, and earthed at frequent intervals for protection against lightning. In all cases where the overhead line enters or leaves a building, lightning arresters of the standard B.T.H. alternating current type have been installed.

For the underground road crossings a special steel terminal pole has been designed (fig. 5), on the top of which is fitted a dividing box into which the high-tension overhead wires are led, and there connected to a three-core high-tension cable, which is led down the inside of the pole and brought out at the bottom into a junction box. The cable from this point is laid solid in a wooden trough to the steel terminal pole on the opposite side of the crossing where it is connected through another dividing box to the high-tension line, which proceeds overhead up to the next crossing.

The poles, except at crossings, are of creosoted wood and are set in concrete, on account of the soft character of the soil in which they are planted, most of the land being under irrigation.

From the generating station the line proceeds to the Drainage Board's Saltley Farm, where the line is tapped and led into a sub-station containing three transformers, each of 5 kw. capacity and the necessary controlling switchgear. These transformers are used for supplying energy to three 2½-h.p. motors driving sewage screens, and one 8-h.p. motor driving farm machinery through a countershaft, and for lighting the offices and the house of the superintendent of works. The motors for driving the screens are 200-volt 50-cycle machines, running at 1,420 r.p.m., and are connected to the screens through spur reduction gearing.

From Saltley the high-tension line proceeds towards Minworth to the Troutpool pumping station.

Each pumping station is divided into two rooms, one containing the pump and motor, starting gear and high-tension switch-panel, and the other the transformers.

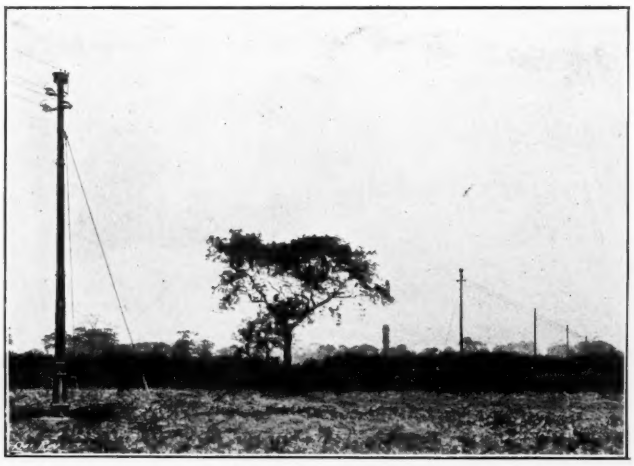


Fig. 5.—Terminal Poles on either Side of a Public Road.

Fig. 6.—High-tension Pole Line.

The Troutpool pumping station contains one 6-in. Gwynne centrifugal pump, designed to raise 696 gallons per minute, against a head of 16 ft. It is direct-connected to an 8-B.H.P. three-phase motor, running at 712 r.p.m. The starting arrangement for this motor is supported on brackets from the floor immediately adjacent to the motor, and the same plan is followed in all the other pumping stations.

The switch panel (which in every case includes a B.T.H. high-tension oil switch for isolating the station from the line) is built into the wall of and projects into the transformer chamber. All parts carrying high-tension current are on the back of the panel, so that it is impossible for accidental contact to be made with the high-tension gear from the front of the panel. The transformer chamber at Troutpool contains two 4-KW. single-phase transformers having a ratio of 2,200 to 200 volts, and is divided from the pump room by a brick partition, the door between being kept locked, and access to it obtained only by the authorised staff of the board; thus the risk of accident, due to ignorance or carelessness, is reduced to a minimum. Similar precautions are taken at all the other stations.

In all the pumping stations the cables connecting the transformers to the switchboard are run in special trenches, covered by chequered plates and readily accessible. All the pumping and sub-stations are arranged in a similar manner, the only difference being in the number of circuits controlled from the sub-station to meet the requirements of the particular area supplied.

From Troutpool the line proceeds to a similar pumping station at Bromford, which, like the Troutpool pumping station, is equipped with a 6-in. Gwynne centrifugal pump direct connected to a motor of 8 B.H.P. capacity. The transformer equipment in this station is also similar to that at Troutpool.

From Bromford the high tension line proceeds to a pumping station at Ashold, which contains one 7-in. pump designed to raise 896 gallons per minute against a head of 32 ft., driven by a motor of 22 B.H.P. capacity, working at 575 r.p.m.

The transformer chamber at the Ashold sub-station contains three single-phase transformers of 10-KW. capacity each: the high tension line, however, is brought into this station underground, whereas, in the case of the others, the overhead line is tapped immediately opposite the sub-station, an offset being taken, and the line led into the building from shackle insulators, to which are connected three highly-insulated cables, which are led through the wall of the sub-station through a special type of porcelain duct. There are two low-tension circuits at Ashold, one for the pump motor and one for the $3\frac{1}{2}$-H.P. motor driving an elevator similar to that at Tyburn.

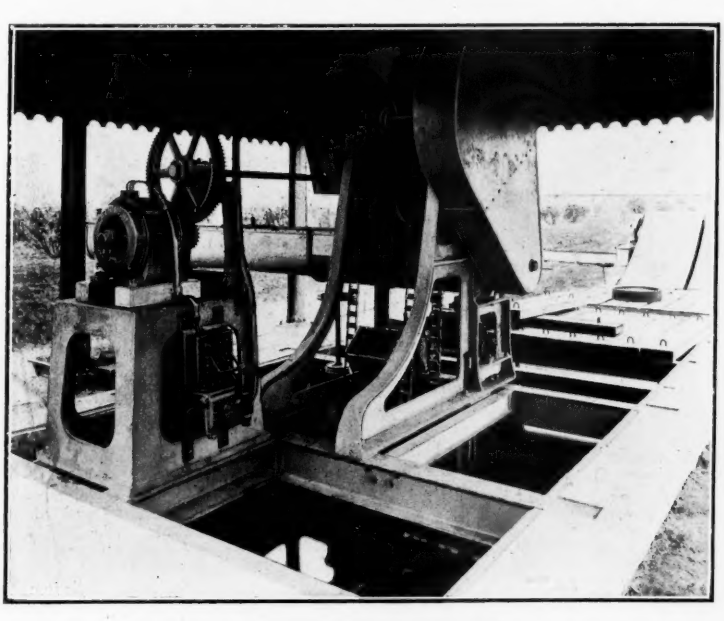


FIG. 7.—VIEW OF INDUCTION MOTOR, DRIVING A SEWAGE ELEVATOR.

From this station the high tension line proceeds direct to Tyburn, where the largest pumping and sub-station is situated. This station is also connected to the high-tension line by underground cable, the transformer chamber contains three 15-KW. single-phase transformers and three $7\frac{1}{2}$-KW. single-phase transformers, each being arranged for a ratio of 2,200 to 200 volts. The larger transformers, are for the power circuits, and the smaller ones for the lighting circuits; they are all of the B.T.H. standard "oil-cooled" type.

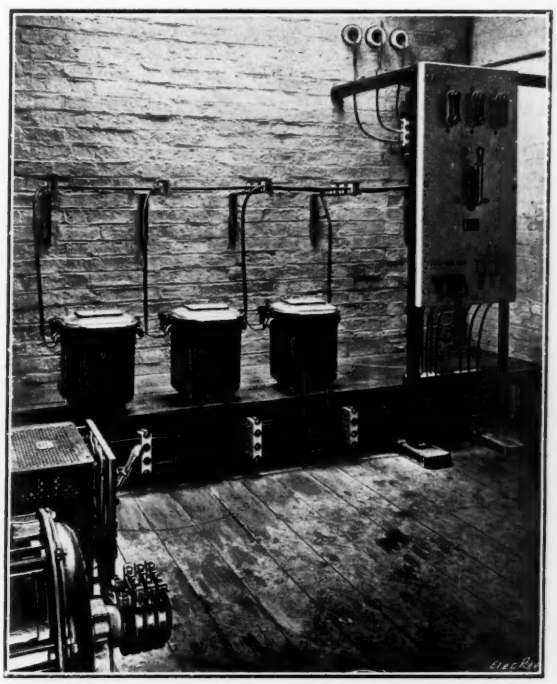


FIG. 8.—SALTLEY SUB-STATION: TRANSFORMER ROOM.

At Tyburn the three power circuits are as follows:—One controls a motor of 8 H.P., running at 960 r.p.m., and an 11-H.P. motor running at 965 r.p.m., used for the operation of general farm machinery and for driving machinery in the mechanics' and joiners' shops, where the mechanical repairs required to the existing plant on the Board's estate are carried out, and any special tools required on the estate are made.

A second circuit controls the pumping station proper, which, as in the case of the other stations, is immediately adjacent to the transformer chamber and contained in the same building. This station contains a Gwynne 8-in. centrifugal pump, designed to raise 963 gallons per minute against a head of 30 ft., and direct-coupled to a three-phase induction motor of 22 H.P. running at 575 r.p.m.

A third circuit controls a $3\frac{1}{2}$-H.P. motor with a speed of 1,420 r.p.m. for driving a sewage elevator. The cable supplying this motor is partly underground and partly overhead.

The secondaries of the lighting transformers are connected to a special switchboard from which the circuits for the offices, engineer's residence and the home farm buildings are controlled; the cables for supplying these circuits being laid underground from the sub-station to the various buildings.

The high-tension line continues from Tyburn to Plant's

Brook, which has the heaviest duty of any of the pumping stations on the estate. This station is used for pumping only, and contains one 10-in. Gwynne centrifugal pump designed to raise 1,900 gallons per minute against a head of 17 ft.; it is direct-connected to a 28-H.P. three-phase induction motor, running at 475 r.p.m. The transformer chamber contains three 10-KW. single-phase transformers having a ratio of 2,200 to 200 volts and the usual controlling switchboard.

Near this station the high-tension line is led into a conduit laid for the purpose under the Midland Railway in 1900, and thence to Minworth Greaves, where at present it terminates. The sub-station at the latter place is used for supplying power to operate two sewage distributors, which were previously operated mechanically, and are used for distributing sewage over circular bacteria beds. This sub-station contains three transformers having a ratio as before of 2,200 to 200 volts and the necessary switch gear.

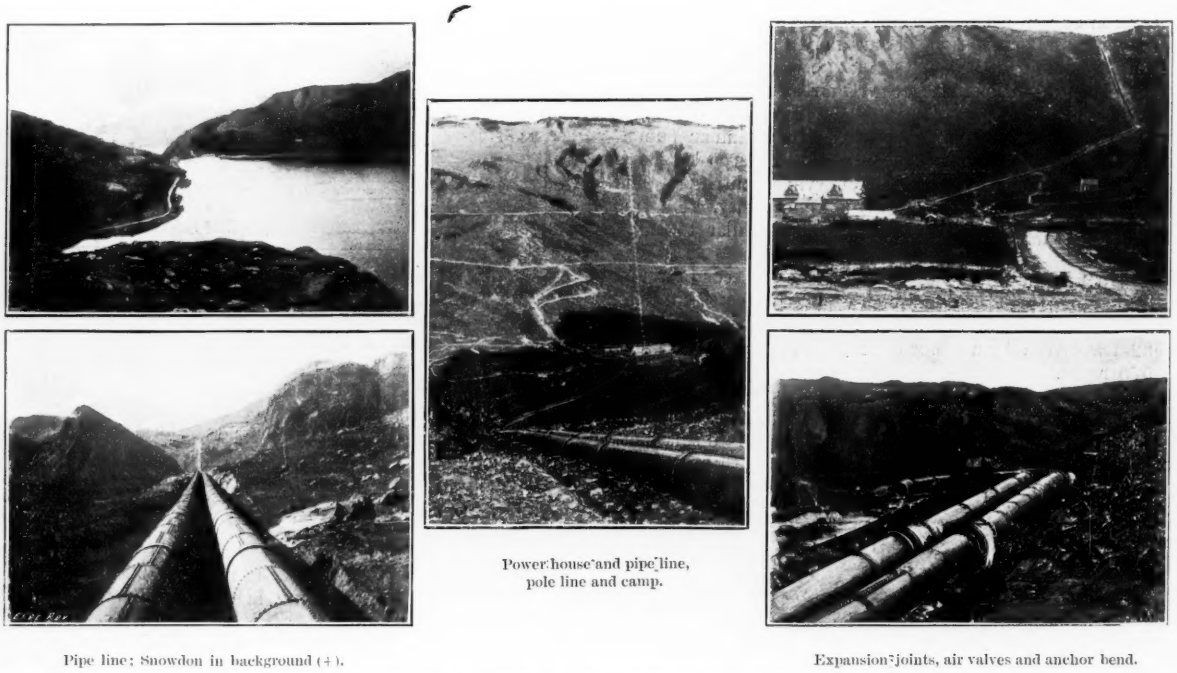
Provision has been made under a new contract to extend the high-tension line from this point one half-mile further towards Curdworth, where the Drainage Board are carrying out very extensive works in the building of bacteria beds, which it is intended to light with arc lamps, and to provide with electrically-operated gravel-washing machinery.

It is also intended to extend the use of the electric power by installing silt pumps 400 yards from the Minworth Greaves terminus. These pumps will be supplied with current at a pressure of 200 volts, direct from the same sub-station which supplies the gravel washer.

The scheme, as a whole, is interesting alike to the electrical and sewerage engineer; Mr. J. D. Watson, engineer to the Drainage Board, and the electrical contractors, the British Thomson-Houston Co., are equally to be congratulated in carrying through such a workman-like project.

Lake Glaslyn, 1,970 ft.

Power house and pipe line.



Pipe line; Snowdon in background (+).

Power house and pipe line, pole line and camp.

Expansion joints, air valves and anchor bend.

Views on the North Wales Hydro-Electric Installation.

## POWER TRANSMISSION IN NORTH WALES.

Standing, as it does, so far behind both America and the Continent in the matter of high pressure overhead transmission, this country will watch with considerable interest the development of the work which is now being carried out in the Snowdon district by Messrs. Bruce Peebles & Co., of Edinburgh, as contractors for the North Wales Power and Electric Traction Co. We are on the threshold of a new era, in which, by granting to power companies the right to transmit electricity at high pressure on bare overhead wires, as is usual in most other countries, Great Britain will be less handicapped in the commercial race than she has been in the past.

This will be the first hydro-electric power transmission scheme on a considerable scale to be carried out in Wales, and we have particular reason to hope that the scheme may be in every way a success, on account of the trying climatic conditions which exist in a country with such a heavy rainfall as characterises the more mountainous district of Wales.

The water supply is furnished by lakes Llyn Lydaw, 1,415 ft., and Glaslyn, 1,970 ft. above the sea level, which lie at the very foot of Snowdon, close to the path leading from Pen-y-Gwryd up to the summit of the mountain—a route much favoured by those who ascend on foot instead of taking the railway from Llanberis.

The pipe line taps the lower of these two lakes some 30 ft. below the natural water level by means of a long tunnel cut in the solid rock, which admits the water to the upper end of the line, consisting of riveted pipes of $\frac{9}{32}$ in. steel plates and 2 ft. 6 in. in diameter; these measurements are varied, as the pressure increases, to $\frac{11}{32}$ in. thickness and 2 ft. 3 in. in diameter at the lower end of the line. The pipes average about 19 ft. 3 in. in length, and some 450 sections are employed between the lakes and the power house, the line being nearly 2 miles in length.

Just above the power station, and at the head of the steepest incline, expansion joints and air valves have been placed. On this, the steepest portion of the line, in addition to anchoring each pipe-joint to over a ton of concrete, the pipe has been bedded in four masses of concrete of more than 35 tons each, one of which is placed at the bend of the pipe on the hillside. The pipes are further secured by backstays placed at frequent intervals, consisting of $1\frac{1}{2}$-in. iron rods bolted to oaken beams sunk in the hillside. The head of water available is nearly 1,200 ft.

The power house is a handsome greystone building, which in any other position would look imposing enough, but, when viewed from the sides of the hills amongst which it nestles, looks more like a toy house than a building 50 ft. in height. The length and breadth are 145 and 45 ft. respectively, exclusive of that portion which is to contain the Ferranti switchboard.

The prime movers consist of four Pelton wheels coupled direct to Bruce Peebles three-phase alternators of the revolving field type, each with an output of 1,500 K.V.A. at

10,000 volts 50 periods when running at a speed of 500 r.p.m.

Space has been left in the power house for the erection of two more alternators and wheels as the load increases.

The transmission line, which is intended to carry current at 10,000 volts, runs from the power station in a north-westerly direction towards Llanberis, and in a south-westerly direction to the famous Oakley Quarries, in the neighbourhood of Blaenau Festiniog. On certain portions of the line, notably those parts known as Sections 5 and 6, considerable difficulties were met with on account of the labour involved in distributing poles, cement, ballast and other heavy materials over mountains totally devoid of even a foot-path. The poles had in some cases to be set in the face of the cliff, and in others in a quaking bog. Poles 32 ft. and 38 ft. in length have been used, giving a minimum clearance of 18 ft. from any part of the ground to the line; they are set in concrete where necessary.

The wires are carried on insulators supported by either galvanised iron brackets or the usual wooden cross-pieces bolted to the poles. The galvanised iron pins which bolt into the brackets are cemented into the insulators by means of a mixture of litharge and glycerine. The iron brackets are all placed on the same side of the pole, and are at a distance of 2 ft. from each other, the highest being 8 in. from the top of the pole, which is capped by a heavy plate of galvanised iron of the usual form. Where a change in the direction of the line occurs, heavy strut poles bedded in concrete have been placed in order to carry the extra strain. Eventually there will be over 130 miles of overhead mains in the area supplied by the company.

In order to overcome the difficulties of distribution of the heavy material used, it was necessary to construct on Sections 5 and 6, lying between the power station at Cwm Dyli and the railway station at Roman Bridge, a tramroad some 5 miles in length, worked on the easier grades by horse traction, and where the incline is too steep, by means of steam winches. The economical building and maintenance of this track over a broad tract of boggy country during a period of incessant rains has been not the least of the problems which had to be faced by the contractors. Those sections which were traversed by the splendid coaching roads which cross the best known passes presented fewer difficulties in the matter of transportation of material, and greatly lightened the labour of the engineers in charge of the work.

Besides supplying power to the quarries, mills, &c., in the area, the station will supply a three-phase railway, 20 miles in length, with electrical energy. A considerable load has already been booked, and the works will commence operations very soon with motors of 4,000 H.P. connected. As coal is dear, and there is an enormous demand for power in the quarries, &c., the prospects before the undertaking are very bright.

The consulting engineers for the power and railway scheme are Messrs. Harper Bros. & Co. and Sir Douglas Fox and Partners. Mr. W. V. Waite and Mr. A. W. Beuttell are resident engineers for the contractors, and the whole work, we understand, has been carried out under the supervision of Mr. Oborniack, the engineer representing Messrs. Ganz & Co., Buda-Pesth.

## CONTRACTS CLOSED.

(*Concluded from page* 930.)

**G.W.R.**—Messrs. Newtons, Ltd., Taunton, have received a repeat order for a number of "Mawdsley" motors from the G.W.R. Co., for driving machinery in their locomotive workshops at Swindon.

**Leyton.**—The U.D.C. has accepted the tender of Messrs. Edgar Allan & Co., Ltd., for the supply of tramway lay-outs, at £1,660.

The U.D.C. has received the following tenders for the installation of the electric light at the Lea Bridge branch library:—

| | | |
|---|---|---|
| Troup, Curtis & Co., London .. | (accepted) | £135 0 |
| J. T. Halsey .. .. .. .. .. | | 149 17 |
| Headland & Headland, Leyton .. .. .. | | 145 16 |
| Marshall & Co., Leytonstone .. .. .. | | 176 10 |
| Murrell Bros., Harringay .. .. .. .. | | 146 0 |
| Ryan & Co., Leytonstone .. .. .. .. | | 175 0 |
| W. Simmons, Stratford .. .. .. .. | | 178 0 |

**London.**—Fulham.—The B.C. has accepted the following tenders in connection with the electricity undertaking:—

Condenser pipes, Messrs. Westwood & Wright, £427.
Meters, the General Electric Co., 70 at 3 amperes, £1 17s 6d. each, 30 at 10 amperes, £1 19s. 6d. each.
Electric lighting fittings for Town Hall extension, Messrs. Spittle, £299.

Marylebone.—The Electric Supply Committee received the following tenders for a milking booster and switchboard:—

| | | |
|---|---|---|
| Phœnix Dynamo Manufacturing Co. | (provisionally accepted) | £82 |
| Electromotors, Ltd. .. .. .. .. .. .. .. | | 98 |
| Siemens Bros. & Co., Ltd. .. .. .. .. .. .. | | 103 |

The Committee has provisionally accepted the tender of the British Thomson-Houston Co., Ltd., at £135 10s., for two spare armatures for the motors driving the induced draught fans at the generating station; and has further placed an order with Messrs. Babcock & Wilcox to carry out the work in connection with the foundations for two future boilers, at £850.

L.C.C.—The Highways Committee of the L.C.C. has obtained the following prices for the construction of conduit lines over the new Vauxhall Bridge:—

| | |
|---|---|
| J. Mowlem & Co. .. .. .. | £4,995 0 0 |
| J. G. White & Co. .. .. .. | 5,200 12 7 |
| Dick, Kerr & Co. .. .. .. | 5,543 16 7 |
| C. Wall .. .. .. .. .. | 6,520 0 0 |
| L.C.C. engineer's estimate | £5,391 |

The Committee expresses the opinion that the work should be executed by Messrs. Mowlem & Co. The amounts of the above offers do not include the necessary rails, which are estimated at £5,300.

**Manchester.**—We understand that Messrs. Wright, Methuen & Co., Ltd., of Manchester, have secured the contract for the electrical installation at the new buildings in Quay Street, Manchester, for H.M. Postal Telegraphs Department.

**Torquay.**—The T.C. has accepted the tender of Messrs. Siemens Bros. & Co. for new machinery, at £7,134, for supplying the tramways load.

**Warrington.**—The T.C. has accepted the tender of Messrs. W. Rouse & Sons, Heckmondwike, for the supply of four tramcar top covers, at £279 18s. 6d.

**Worksop.**—The U.D.C. has just ordered a "Criton" water softener for 1,500 gallons an hour for its electricity station from the Pulsometer Engineering Co., Ltd.

**Carbon Tetrachloride.**—A good deal of attention is being bestowed at the present time upon the substance known as carbon tetrachloride or tetrachloromethane, a body which is being made at Niagara by the Acker process from electrolytic chlorine. It is a heavy liquid having a specific gravity of 1·593 at 20° C., but it is fairly volatile, boiling at 76° C. Being an excellent solvent of oils and grease, carbon tetrachloride has been employed as a substitute for petroleum spirit or benzol in "dry-cleaning" works, but its use has been objected to on the ground that its vapour exercises a harmful, if not poisonous, action upon the operatives. In this particular carbon tetrachloride may well be inferior to petroleum spirit, but it can hardly be much more toxic than benzol, the coal-tar aromatic hydrocarbon. Recently it has been proposed to employ carbon tetrachloride instead of petroleum spirit for the extraction of grease from bones. It is stated that the grease recovered by means of the tetrachloride has a better colour and less odour, and is therefore worth two or three shillings per cwt. more than the grease extracted with light petroleum. The putrescent matter of the bones is soluble in petroleum spirit, but not in carbon tetrachloride, so that the latter solvent yields an almost odourless product. Moreover, the odour of petroleum adheres firmly to the grease extracted with its aid, whereas that of the carbon tetrachloride can easily be removed with a current of steam. The new solvent does not injure the gelatinous matter of the bones, and they are accordingly better suited for the manufacture of glue. It is claimed on behalf of carbon tetrachloride that so much less cooling water is required in the extraction plant, and the premiums for fire insurance are so much reduced that it has a good chance of superseding petrolum spirit for the present purpose. There is, however, a loss of solvent equal to about five or six parts by weight per 1,000 parts of bones treated, which represents a loss of some three shillings per ton of bones; and it does not seem that existing plants designed for petroleum spirit can be properly used with carbon tetrachloride. It is rather interesting to observe that the proposal to employ the electrolytic product carbon tetrachloride for the purpose of grease extraction has come to the front almost at the same time as that for the use of acetylene tetrachloride or tetrachlorethane in a similar way. Tetrachlorethane is prepared from chlorine and acetylene; the acetylene is obtained from calcium carbide, a product of the electric furnace, and the chlorine may be electrolytic as well. As might be expected, tetrachlorethane is considerably less volatile than the corresponding methane compound, its boiling point being about 146° C. Trichloromethane is also an excellent oil solvent, but has other more important applications, for it is the systematic name of chloroform.

## FORTHCOMING EVENTS.

**To-day's Events** (Friday, December 8th).—At 7.30 p.m. I.E.E. (Manchester Students). Mr. W. H. M. Parr on "The Electrification of Existing Steam Railways."
At 7 p.m. I.E.E. Annual dinner at the Hotel Cecil.
At 8 p.m. At Northampton Institute. Prize distribution by Sir Wm. Preece, and Conversazione.
At 8 p.m. Physical Society Meeting.

Saturday, December 9th.—Glasgow Technical College Scientific Society. Fourteenth Anniversary Dinner.
At 10.30 a.m. I.E.E. (Students) visit to Bow Electricity Works, Marshgate Lane, E.
At 2 p.m. North of England Institute of Mining and Mechanical Engineers. Meeting at Newcastle.
At 7.30 p.m. Birmingham and district Electric Club. Annual general meeting at Colonade Hotel.
Monday, December 11th.—At 8 p.m. Society of Arts. Cantor Lecture, by Dr. J. A. Fleming, on "The Measurement of High-Frequency Currents and Electric Waves." (Lecture III.)
At 7.30 p.m. I.E.E. (Manchester.) Mr. H. Harrison on "Street Lighting."
I.M.E. (Graduates). Mr. A. W. Waddy, on "Organisation in Small Engineering Works."
Tuesday, December 12th.—At 8 p.m. I.E.E. (Glasgow). At 207, Bath Street. Dr. J. Erskine-Murray on "Recent Advances in Wireless Telegraphy."
Nottingham Guild of Mechanical and Electrical Engineers. Mr. G. Preece on "Electric Cables."
At 8 p.m. Electrical Contractors' Association (London). At Frascati's Restaurant. Mr. Alger on "Electricity *v.* Gas."
At 8 p.m. I.C.E. Further discussion on paper on "The Steam Turbine," by the Hon. C. A. Parsons and Mr. G. G. Stoney.
Wednesday, December 13th.—At 7.30 p.m. I.E.E. (Birmingham.) The University. Mr. S. H. Holden on "Two New Electricity Meters."
At 8 p.m.—Association of Engineers-in-Charge. Mr. J. W. Blakely on "High-Pressure Gas Illumination."
At 7.30 p.m. I.E.E. (Students). "Flame Arc Lamps," by Mr. L. J. Pumphrey.
At 7.30 p.m. Wolverhampton and District Engineering Society. Mr. Geo. Bulkeley on "The Locomotive of To-day."
Thursday, December 14th.—At 3 p.m. Tramways and Light Railways Association. Visit to Lot's Road power station.
At Rugby.—Rugby Engineering Society. Mr. P. A. Mossay on "High-Lift Pumps."
At 8 p.m. I.E.E. Adjourned discussion on Mr. W. H. Patchell's paper on "The Charing Cross Co.'s City of London Works."
Friday, December 15th.—At 7 p.m. Physical Society. An Exhibition of Electrical, Optical and Physical Apparatus.
At 8 p.m. Electro-Harmonic Society. Smoking Concert and Presentation of Souvenirs to the members of the Electrical Exhibition Executive Committee.
At 8 p.m. I.M.E., at Storey's Gate. Adjourned discussion on seventh report to the Alloys Research Committee by Dr. H. C. H. Carpenter and Messrs. R. A. Hadfield and P. Longmuir.
At 8 p.m. Junior Institution of Engineers. Prof. J. T. Morris on "Electric Mains for Power Transmission Work."
At 8 p.m. I.C.E. (Students). Mr. E. E. Mann on "Tests of Street Illumination in Westminster.
Saturday, December 16th.—At 7.30 p.m. Glasgow Technical College Scientific Society. Mr. W. D. Hamilton on "The Economy of Power Production—Relative Merits of Gas and Steam Engines for Various Purposes."
At 10 a.m. Junior Institution of Engineers. Visit to Messrs. Johnson and Phillips's Old Charlton Works.
I.E.E. (Manchester Students). Visit to Stuart Street generating station. Meet at Queen's Statue at 2 p.m.
Friday, December 22nd.—At 7.30. I.E.E. (Manchester Students). Mr. J. C. Ward on "The Electrical Equipment of Automobiles."

## THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, December 11th.—"A" Company, recruits' drill, 6 p.m.; technical instruction, 7 p.m.
Tuesday, December 12th.—"B" Company, technical instruction, 7 p.m.; medical inspection, recruits, 7 p.m.
Wednesday, December 13th.—"A" badge examination.
Thursday, December 14th.—"C" Company, technical instruction for the whole company at 7 p.m.
Friday, December 15th.—"D" Company, technical instruction, 7 p.m.
Saturday, December 16th.—Week end instruction for "A" Company (whole day). "A" Company Supper, 7 p.m., at headquarters.

Wilfrid C. Dumble, Captain E.E.
For O.C.E.E.R.E. (V.).

## NOTES.

**Short Circuits as Causes of Fire.**—Prof. Kubler, of Dresden, read a paper on the supposed dangers of electrical installations before the recent general meeting of the German Institution of Naval Architects at Berlin. It was mentioned that in the case of the majority of fires the public simply attributed the cause to a short circuit. Many investigations had taken place of fires in buildings not electrically lighted, but the cause was returned as being due to a short circuit. In one instance near Dresden, a shed was burnt down, and the owner explained that the fire was due to a short circuit. It appeared that the shed was actually wired, but the supply had been cut off a long time previously, because the owner had not paid for the energy consumed.

**By a Mains Man installing Cables in a Coal Mine.**—

Of sunlight sweet I have no power to sing,
I cannot ease the burden of your fears;
Or make of dismal shaft a pretty thing,
Nor bring again the pleasures of past years—
Those cables laid 'mid trees by silvery meres,
Or tramway mains laid in the light of day,
Or seaside networks in the month of May!

The heavy cables, the bewildering care
Which stalks your mind by day, by night your bed,
My idle verses have no power to share,
They cannot transmigrate the black pit head.
The work on Sabbaths (wishing you were dead),
The dust and wet careering down your neck,
Your only jointer drunk, a helpless wreck . . .

And then when you, aweary of the earth,
Have done the work, and wearily ye sigh
For something cleaner, something nearer mirth:
When, after many days, again you see the sky
Erstwhile forgot, and shines again the eye—
Behold, a letter from your firm to say:
"*Go to another coalpit job* TO-DAY."

Duplicator.

**A Westphalian Electrical Monopoly.** — It is considered probable that the Rhenish-Westphalian Electricity Works Co., of Essen, which was formed several years ago for the supply of light and power in that town, will gradually obtain a monopoly in that part of Germany which constitutes the heart of the coal and iron and steel trades. Associated with the undertaking are the principal coal and iron magnates and such leading financial institutions as the Deutsche Bank, the Dresdner Bank and the Disconto Gesellschaft, and the combination, therefore, renders everything possible where enterprise and money in conjunction are able to decide matters. The company, which has a generating station at Essen, has already acquired the electric lighting undertakings of several local authorities, and is in negotiation with other communal councils for the purchase of their works. In addition, the company has another large power station newly-erected at the Wiendahlsbank Colliery, and a supply of electrical energy is furnished to a number of towns, local authorities, coalmines and iron and steel works. In fact, the industrial load is of considerable importance to the company, as it starts at 6 a.m. and ceases about 2 p.m., while the lighting load commences about half-past three o'clock. In many cases the company has agreements with the mining companies for the supply of power, these including such important works as the Deutscher Kaiser, Thyssen & Co., the F. Krupp Co., the Mulheim Mining Association, the Friedricks-Wilhelmshutte, the Gelsenkirchen Mines, the Harpen Mining Co., the Bochum Union and many others. The Government authorities are also customers of the company, and it is being suggested that in order to protect the public in general, the State and the consumers should become financially interested in the increasing share capital of the Essen Co.

**A New Wire Insulation.**—In our issue of the 1st inst. we described at length a new system of insulating wires, for which an important claim was that it enabled a thin yet effective insulation to be given. From the *Western Electrician* we gather that Germany has recently produced a new insulated wire, in which the insulation is exceedingly thin, but at the same time a successful dielectric, possessed of elastic properties. This new insulation, when used for very fine wires, is formed of acetic cellulose applied by a special machine. Although tough, supple and elastic, the insulation is said to have a thickness of but 0·03 millimetre. It is further asserted that the insulation is unaffected by humidity or a temperature of 150° C., and will suffice for a pressure of 1,500 volts. For coarser wires up to two millimetres in diameter the insulation is formed of another substance of similar qualities, resembling enamel in external appearance. The latter form possesses nearly perfect elasticity and flexibility, with insulating qualities permitting it to withstand 2,000 to 2,500 volts. Unaffected by humidity, it resists a temperature up to 200° C. The insulation being exceedingly thin (between 0·015 and 0·025 millimetre) its success in many applications appears to be assured.

**New York Electrical Society.**—The centenary of the birth of Benjamin Franklin, January 17th, 1906, is to be celebrated with much distinction in the United States. Owing to the number of functions on hand for the evening of that day, the New York Electrical Society, the oldest electrical society in America, has decided to hold its "Franklin Night" on the 16th. Mr. Marconi, who had engaged to lecture before the Society in January, has expressed his desire to render his tribute to the memory of the great electrical inventor, and his address has, therefore, been fixed for that evening.

**The Physical Society's Exhibition of Apparatus.**—We have before us an advance programme of the exhibition which is to be held by the Physical Society on Friday evening, 15th inst., at the Royal College of Science, South Kensington. Invitations have been issued to members of the Institution of Electrical Engineers, the Röntgen Society, the Optical Society, and the Faraday Society. Admission will be by ticket only. The leading instrument makers will be exhibiting various electrical, optical, and other physical apparatus, and the occasion bids fair to be one of considerable interest and profit to those who can make the opportunity to be present.

**A Forthcoming Presentation.**—An interesting—certainly a most unusual—item in the programme of the next Electro-Harmonic Smoking Concert will be the presentation of souvenirs to the members of the Electrical Exhibition Executive Committee. The success of the show at Olympia was largely due to the good work of Mr. Cunliffe Owen and his committee; and the exhibitors, desiring to express their thanks and appreciation, have chosen this method. Mr. John Gavey, C.B., President of the Institution of Electrical Engineers, has consented to make the presentation. The concert will be held at the King's Hall, Holborn Restaurant, on Friday, the 15th inst. It begins at 8 p.m., and the presentation will take place during the interval. Tickets of admission to the concert have been furnished to all contributors through the courtesy of the Electro-Harmonic Society.

The programme issued by the secretary of the Electro-Harmonic Society for the smoking concert announces the following items:—

*Vocal Music:* By Messrs. Gwilym Richards and William Forington.

*Instrumental Music:* Solos and a duet by Mr. T. E. Gatehouse (violin) and A. E. Izard (pianoforte); also concertina solos by Mr. Alex. Prince.

*Miscellaneous Items:* Humorous recitations by Mr. W. G. Churcher; humorous songs by Mr. Walter Walters; and humorous sketches by Mr. Frank Leedam.

Mr. John Gavey, C.B., is to preside.

**Electric Lift Accident.**—An inquiry was held at the City Coroner's Office on November 23rd as to the death of a youth who was killed at the Central News Building. The deceased, whose age was given as 15, was employed to work the electric lift, and, according to the evidence, he had had three days' tuition by the makers, who considered him to be quite proficient. It was not clear from the evidence precisely how the accident occurred. It was stated that, after going down into the basement to switch on the current, he ascended to the first floor; and whilst he was in the act of clearing out the lift, the cage descended and guillotined him between the top of the lift door and the floor, death being due to suffocation owing to pressure on the chest. The boy's position suggested that he was reaching into the lift to turn off the handle. Subsequent inspection showed that the switches were "on" but the main fuses were blown—due, of course, to the lift having been jammed. The Home Office Inspector was of opinion that the lift was in proper working order, and was fitted with a number of safety appliances; he could suggest nothing that would make it safer, except that the handle on the inside of the cage should be capable of being removed.

The jury made a strong and emphatic recommendation to the effect that a boy of 15 should not be employed on an electric lift. He was jeopardising not only his own life, but the lives of the passengers carried. They were of opinion that the instruction given was insufficient and haphazard, and called attention to the fact that the boy was working 11½ hours a day.

There have been upwards of 30 lift inquests during the past five years in the City alone. It is important, therefore, in the interests of the electrical industry, that every reasonable precaution in the design of the operating gear of electric lifts should be taken. It appears that the operating handle of the lift in question was removable and ought to have been removed, but this is a matter of course depending upon the carelessness or otherwise of the lift attendant.

As to the jury's recommendation that a boy of 15 should not be in charge of a lift, it might be pointed out that there are many lifts in the City in which there are no attendants at all. We refer to lifts worked on the push-button principle. It is, however, possible to design electric lifts in such a way that they cannot be operated unless the lift doors are shut, and such a design, it appears to us, would prevent such an accident as the one in question.

We trust that, in view of the above and other cases which have occurred, electric lift makers will realise that to some extent the interests of the industry generally may be jeopardised by such unfortunate occurrences, and that they will do their utmost to design their apparatus so as to make them as safe as is humanly possible. Electric lifts are much more economical in operation than hydraulic or mechanically-driven lifts, and if it can be shown that they are safer it will be an additional inducement for their adoption.

**Electro-Chemical Notes.**—The seventy-seventh annual meeting of the German Society of "Naturforscher und Aerzte" was held at Meran during the week ending September 30th last. In the Applied Chemistry section several papers were read of considerable interest, and of some of them we give an account in the following lines.

*The Anodic Attack of Iron by Stray Earth Currents.*—Dr. F. Goldschmidt, of Essen, read a paper on this subject, which contained the results of some investigations carried out by Dr. Bunte, of Karlsruhe, Prof. Haber, and himself; the chief point under consideration being the influence of any acidity or alkalinity in the ground water upon the attack of iron pipes by stray earth currents. It has been found that the iron does not become passive, as might be anticipated, when the soil is alkaline; the reason being that the earth hinders diffusion, just as happens when an iron anode is surrounded by a diaphragm of animal membrane or the like. Such an anode is attacked in a solution of an alkali metal carbonate, presumably because the anodic liquor gradually comes to contain some bicarbonate. In ordinary conditions the layer of bicarbonate next the anode diffuses away, normal carbonate taking its place. When, however, this diffusion is hindered through the presence of a diaphragm, the bicarbonate concentration increases until passivity is no longer possible. In the solution of a caustic alkali the iron is prevented from becoming passive by the presence of chlorides; an observation which agrees with Mugdan's statement that iron rusts progressively in a chloride solution. Between active and passive iron there exists such an electro-motive difference that the former is as negative towards the mercury of a decinormal electrode as the passive iron is positive thereto. For the purpose of studying the effects produced by stray currents issuing from tramlines and escaping into the earth, a portable non-polarisable electrode of zinc in zinc sulphate paste can be made, which permits of convenient and accurate work being done. In the course of a discussion following the paper, Dr. Goldschmidt stated that already a good deal of damage had been done in Germany by stray electric currents.

*The Manufacture of Lampblack and Graphite from Calcium Carbide.*—A paper was read before the same section of the Society by Dr. Adolf Frank, of Charlottenburg, describing a new process devised by Drs. Albert Frank, N. Caro, and himself, for obtaining either lampblack or graphite from calcium carbide or from acetylene previously generated therefrom. The process is carried out in two different ways. When a mixture of acetylene with either oxide of carbon is caused to explode, all the carbon present is recovered in the form of a lampblack, which is stated to be a pigment of exceptional blackness and covering power, superior to the best grades of American gas or carbon black. When, however, a current of either oxide of carbon is led over a heated metallic carbide, the reaction is so energetic that the temperature of the mass is raised considerably. All the carbon present is recovered, as before, in the free state, but it is obtained as a graphite mixed with the metallic oxide. If the latter is extracted by suitable mechanical and chemical means, a pure graphite free from ash is left, and it is said to be fully equal in all respects to the graphite manufactured by Acheson in the electric furnace. It is put forward as an additional merit of the new process that the calcium carbide employed is the dust or smalls produced during the crushing and grading of ordinary carbide; and the dust is essentially valueless for any other employment, such as the generation of acetylene.

*The Value of Calcium Cyanamide.*—In the agricultural section a paper was read by Prof. Frank upon last summer's experiments with calcium cyanamide, the new fertiliser. The general outcome was that calcium cyanamide is undoubtedly a valuable fertiliser, which is actually some 20 or 25 per cent. less efficient than sodium nitrate, but occasionally proves fully equal thereto.

*Electrolytic Production of Zinc from Sulphate Solutions.*—A German patent has been granted to Siemens & Halske, of Berlin, for a process of electrolysing zinc sulphate solutions with an insoluble anode. Hitherto, it is said, processes of this kind have proved troublesome to work, owing to the formation of a zinc mud, and to the action of the liberated sulphuric acid upon the metal deposited at the cathode. These difficulties are stated to be overcome in the new process, the essential feature of which is that the current density all over the insoluble anode, or at certain spots thereon, is several times higher—preferably 20 to 50 times higher—than the density at the cathode. For the treatment of the most concentrated solutions of zinc sulphate that it is practicable to use, the cathode current density should be about 150 amperes per square metre; and the corresponding anode current density should therefore range between 3,000 and 7,500 amperes. The form of the anode is immaterial, provided its localised or general current density is sufficient. To attain this object, the superficial area of the anode itself may be appropriately reduced in proportion to the size of the cathode, or it may be constructed of equal area to the cathode, but with ribs, inlaid wires or the like, so that its higher conductivity at those places may cause it to possess the required high current density. When the whole anode is made small, it may be composed of platinum or an alloy thereof, for then contamination of the electrolyte with foreign matter from the anode is entirely avoided. The process is claimed to give a crystalline and perfectly solid deposit of zinc, which is smooth and free from lumps, resembling in outward appearance electrolytically-refined copper (except presumably in colour).

*Electrical Steel in Germany.*—The proprietors of the calcium carbide factory at Gurtnellen have decided to increase their capital in order to be able to lay down plant for the electrical manufacture of steel according to the Kjellin system. At first they intend to work on a comparatively small scale, a 500-H.P. furnace being installed, which was expected to be ready by the end of November. The Röchling iron and steel works at Völklingen have also partly adopted the electrical process, a 1,500-H.P. furnace being already in process of construction. It is reported that several other important blast furnace works contemplate a similar excursion into the domain of electro-metallurgy.

**Electric Shock Fatality.**—An inquest was opened on Saturday last at Newcastle into the cause of the death of J. T. Curry, a fitter at the Bushy Pit, Pelton Colliery. From the evidence given by Jacob Robson, jun., it appears that he was working with Curry in the blacksmith's shop, and the electric lamps were lighted. As the light was not strong enough, an electric lamp, with flexible cable attached, was held by Curry. The cable was attached to the lighting circuit. Curry was on the floor, and having picked up the lamp and switched the light on, he walked about 4 yards along the shop floor towards witness, who was on the shafting in the roof. He heard deceased shout "Jake!" and on looking round saw Curry lying on his back on the floor. The lamp was still in his hand, lighted. Witness thought he had hold of the lamp with both hands in front of his breast, the handle touching his body. When the witness pulled off the main switch, the lamp was extinguished.

According to a report in the Newcastle' *North Mail*, J. W. Armstrong, electrical engineman at Pelton Fell Colliery, also spoke of seeing Curry holding the lamp. He touched Curry and received a slight shock, and found that Robson had turned off the wrong switch. He turned off the right switch, and then took the lamp from Curry's hand. Armstrong added that there was only a voltage of 120. He had received a shock at 440 volts. Curry would receive the current for about four minutes. Further evidence showed that on the night in question there was a leakage, and Curry might have received 254 volts.

The jury found that Curry was accidentally killed through receiving an electric shock from a portable electric hand lamp whilst following his employment.

**Electric Lift for the River Weaver.**—It is stated that nearly £20,000 is to be expended by the River Weaver Trust in reconstructing the Anderton lift and substituting electrical for hydraulic power. Parliamentary powers have been granted for an expenditure of £30,000.

**Claim against Leicester Corporation.**—A claim has just been settled by the Leicester Corporation, in which Messrs. Walker & Sons, hosiery manufacturers, claimed against the Electric Tramways Committee that goods were damaged by smuts from the tramways power station chimney. They demanded £1,500 compensation. Expert evidence was obtained by both parties, and acting on eminent legal advice the Corporation has settled the claim by paying £500 damages.

**Gas v. Electricity for Street Lighting.**—The Sutton (Surrey) Urban Council has recently been considering this question, and after having before it tenders submitted by the Gas Co. and the South Metropolitan Tramways and Electric Light Co., Ltd., has resolved to go in for electric lighting (Gas journals please note !). The offer of the Gas Co. was £3 14s. per lamp per annum, or £3 12s. under a three years' contract. From the *Sutton Herald* we gather that the Electric Light Co. offered to provide 500-watt flame lamps or other type of arc lamps opposite the fountain at the railway station and at the Cock Hotel, two Nernst or other incandescent lamps of 132 c.p. in the High Street, and 168 Nernst or other lamps for the side streets, for the sum of £737 5s., being the equivalent of £3 12s. 6d. for each incandescent lamp and £17 for each arc lamp. As there would be a heavy capital charge in fixing the lamps, &c., the contract must be for five years. They pointed out that the lamps would give a total candle-power of 17,586, which was about 40 per cent. more than the rated candle-power of the existing gas lamps, and further, that by their agreement with the Council in 1900 they undertook to provide one 16-c.p. lamp burning all night for 70s., and that on the basis of 194 lamps this would give a total illumination of 3,104 c.p. at a cost of £676, whereas now they offered the equivalent of 14,500 c.p. for £703 5s.

Mr. Wakeford, as chairman of the General Purposes Committee, said they had gone very thoroughly into the matter, and had arrived at the opinion that it would be a distinct advantage to the town to light up as much as possible with the electric light. They were getting it at a lower rate than the gas, and there was not the slightest doubt they would get a light far in advance of anything they had at present. He had no hesitation in saying that he believed the electric light people would keep up the standard as specified in their contract. He moved that their tender be accepted.

Mr. Holland seconded, and said that as a progressive body they ought to endeavour to keep up with the times. The matter had received minute consideration from every point of view, and they felt that in installing the electric light they were doing the right thing. Hitherto they had been paying £3 14s. per lamp, which for 551 lamps amounted to £2,038. Presuming that each lamp burnt 5 cb. ft. per hour for 3,639 hours, according to the schedule, that would make 18,150 ft., and at 2s. 8d., with the 5 per cent. off allowed to large consumers, that would mean that their lamps ought to cost them £2 6s. for gas, leaving £1 8s. for cleaning, maintenance, &c. That appeared to him to be a very high charge, he believed that the average was about 17s. 5d., so that it would appear they were being asked to pay something like 10s. 9d. per lamp more than they ought to do. He thought it was quite time the matter was looked into, and that they endeavoured to secure better terms from the company. If they desired to secure better terms the only way of doing it was by competition, and they had thought it right to introduce that competition.

The recommendation was adopted.

We congratulate the Sutton Council upon its decision to pursue an enlightened policy. Had the City Corporation made as fair and complete an inquiry into the question, the retrograde step which has been adopted reverting to gas lighting would never have been taken. The blindness of the City authorities, or something else, appears to prevent them from seeing that it is absolutely unfair to compare the most modern gas systems with a comparatively ancient arc lamp lighting. Surely members of the City Corporation ought to be intelligent enough to understand that since fifteen years ago enormous strides have been made in electric street illumination. There are none so blind as those who, for some reason best known to themselves, won't see !

**King's College Engineering Society.**—The twelfth annual dinner of this society, which has existed for no less than 45 years, was held on November 25th at the Hotel Cecil. Prof. A. K. Huntington took the chair, and amongst the guests were Sir A. Binnie, Sir A. Rücker, Profs. Thomson, Capper, Wilson and Hudson, Mr. C. H. Wordingham, and Mr. F. W. Timmis (president). Mr. M. H. Curry proposed the health of the guests, to which Sir A. Rücker and Sir A. Binnie responded, the latter recalling the time when he was an evening student at the College 47 seven years ago, and urging the students to secure a broad foundation of general knowledge before they began to specialise. Other speeches and a musical programme contributed to the enjoyment of the company.

**Gas v. Electricity.**—Next Tuesday's meeting of the London Section of the Electrical Contractors' Association (Incorp.) promises to be one of considerable interest and importance, for a member, Mr. Alger, of Newport, who is understood to have gone very carefully into the comparative costs and consumption of air of gas and electricity, will read a paper on the subject. The meeting takes place on Tuesday next, 12th inst., at Frascati's Restaurant at 8 p.m. The recent braggart claims of gas advocates render it necessary for all engaged in the electric lighting industry to be fully posted in regard to the real truth of the present controversy.

**The Fire at Shrewsbury Schools.** — The following important communication comes to hand as we go to press:—

"I notice in the newspapers this morning that the cause of the fire at Shrewsbury Schools is put down to the fusion of the electric light wires. I have thoroughly investigated the matter, both yesterday and to-day, and can say positively that this was not the cause of the fire. The whole of the branch fuses were in order on the distributing boards (which were not damaged by the fire), showing that the damage to the wires was the effect of the fire, and was done after the main switches were turned off.

"The fire is supposed to have started some distance from any electric light wires, and due to the flue leading from the heating apparatus.

"The report in the newspapers has come from no reliable source.

"C. M. Johnston, M.I.E.E., M.I.M.E.,
"*Borough Electrical Engineer, Shrewsbury.*
"December 6th, 1905."

Once more electricity has been made the scapegoat. These false accusations are exasperating; but what can we do?

**Appointments Vacant.**—Charge engineer for Southend-on-Sea electricity and light railways department (50s.); mains engineer for Dartford U.D.C.

**Institution and Lecture Notes.**—I.E.E. (Dublin).—On November 30th, in the theatre of the Royal Dublin Society a conversazione was held, there being a very large attendance. The programme opened with a lecture on "High Frequency Electric Current," by the Very Rev. Monsignor Molloy, D.D., and an attractive vocal and instrumental entertainment followed.

Röntgen Society.—Before a meeting of the Society last evening, Mr. J. Butler Burke read a paper on "The Spontaneous Action of Radium and other Bodies on Gelatine Media."

Institution of Civil Engineers.—At the meeting on Tuesday a paper on "The Steam Turbine" was submitted by the Hon. Charles A. Parsons, C.B., F.R.S., and Mr. G. G. Stoney, M.Inst.C.E.

Royal Society.—On November 30th, the annual meeting was held at Burlington House, Sir W. Huggins, president, delivered his address. Lord Rayleigh was elected president for the ensuing year, and the society's medals were afterwards presented. The annual dinner of the society was held in the evening.

Royal Institution.—The following are among the lecture arrangements at the Royal Institution, before Easter:—A Christmas course of six illustrated lectures, adapted to a juvenile auditory, by Prof. H. H. Turner on "Astronomy." Prof. B. Hopkinson, three lectures on "Internal Combustion Engines" (with experimental illustrations); and Prof. J. J. Thomson, six lectures on the "Corpuscular Theory of Matter." The Friday evening meetings will commence on January 19th, when Prof. J. J. Thomson will deliver a discourse on "Some Applications of the Theory of Electric Discharge to Spectroscopy." Succeeding discourses will probably be given by Prof. S. P. Thompson, Mr. W. C. D. Whetham and other gentlemen.

Before the Glasgow Architectural Craftsmen's Society last week, Mr. John D. Mackenzie, A.I.E.E., read a paper on "Electricity as a Home Comfort."

At a meeting of the Nottingham Guild of Mechanical and Electrical Engineers held last week, a lecture on "Steam Boilers of all Kinds" was delivered by Mr. H. J. S. Mackay, of London, expert to the Stirling Boiler Co.

The Hon. Charles Parsons lectured on Saturday night in the Armstrong College, Newcastle-on-Tyne, on "The Future of the Steam Turbine."

**The Charing Cross Disaster.**—In connection with this very sad disaster, it is interesting to learn that at 6.50 p.m. on Tuesday a detachment of the Electrical Engineers Volunteers was telephoned for to bring searchlights from the Headquarters in Westminster to enable the repair work to proceed. Before 8 p.m. 25 men and two field searchlights were on the spot under the command of Capt. J. J. F. Phillips and Lieut. E. Graham Sheppard. A few minutes later the projectors were mounted on tops of railway carriages and the lights concentrated on the places where the repair work was going on, thus enabling very risky work, which would otherwise have been delayed till daylight, to proceed without a break. This is, we believe, the first occasion on which such a thing has taken place, and this lighting will be continued by the Corps every night as long as required. It is very creditable to the Corps that at so short notice they were able to carry out the whole of this work entirely unaided, more especially as the men were not in any way picked, but were simply those who happened to be at Headquarters for drill.

**Dinner of the British Motor Trades Alliance.**—The first annual dinner of this new association was held at the Holborn Restaurant, on Monday last, December 4th. Though the membership of the Association numbers something under 40, it comprises almost all the best firms; its object is to further the interests of British trade, which has had a good deal of stern chasing to do. But though foreign cars still come into the country in increasing numbers, the rate of increase is less than that of British-made cars, and buyers now prefer the British car. Britain, indeed, holds the record for speed. She also holds the record for reliability, and stands high for touring cars. British tires are used on the best French cars, and generally the superiority of the British car is becoming more and more widely recognised. The United States are afraid of the British car to the tune of 40 per cent. tariffs. Electricity has so far not had a very large share of the motor-car industry, apart from its use for ignition purposes; but there is hope yet for the daily improving battery of secondary cells, and the electrical car will undoubtedly in time find a field for its peculiar capabilities in the smooth city streets. Fancy a nerve specialist calling on his patients in a petrol car, with its frequent pistol shots in the exhaust pipe and general clamour. The gentle hum of the electric motor will be half a cure for nerves in itself. It is impossible not to sympathise with the objects of the Association, especially when in their optimistic company. At the same time, we believe nothing would do more to further the interests they have at heart, than a successful clean method of dealing with dust. We cannot forget that the motor-car has been the ruin of many a home by the main roadsides, and that great loss has been incurred by unfortunate owners of houses. A real dust remedy would be of priceless benefit, and would greatly increase the business of the members of the Association.

## OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

**Central Station Engineers.**—Mr. WM. WARD, switchboard attendant at the Blackpool Borough Electricity Works, has secured a similar appointment under Paisley T.C.

The Bolton T.C. has appointed Mr. CLAUDE BARRY, assistant engineer-in-charge of the Blackpool Corporation Electricity Works, as engineer-in-charge of the Electricity Works.

The Dover T.C. has appointed Mr. R. E. HEYGATE as shift engineer at the Electricity Works.

The Leyton U.D.C. has increased the salary of the electrical engineer (Mr. F. H. LEWIS) by £150 per annum.

Illuminated addresses have been presented by the late Dover Electricity Supply Co. to Mr. WOODMAN, electrical engineer, and Mr. BROAD, chief clerk, in recognition of their services to the company, whose undertaking has been taken over by the T.C.

Mr. R. J. J. SWAN, resident engineer to the Empire Electric Light and Power Co., was appointed to succeed Mr. A. H. Seabrook as electrical engineer and tramways manager at Barking at a salary of £225, rising to £300, but he declined to accept, his company having increased his salary to the sum offered by the Council. The Barking Council has since unanimously appointed Mr. HENLEY L. HOWARD, A.M.I.M.E., A.M.I.E.E., of Manchester, to be chief engineer and general manager of the Electricity and Tramways Department. Mr. Howard leaves Manchester on 16th inst.

Mr. B. T. HAWKINS has left the Sheffield Corporation Electric Supply Department to take up the position of shift engineer at Consett for the Cleveland and Durham County Electric Power Co.

According to the *Australian Mining Standard*, a number of the aldermen and officers of the Sydney City Council met at the Town Hall at the end of October to wish a pleasant journey to Mr. T. ROOKE, city electrical engineer, who was about to visit Great Britain and Europe on six months' leave of absence. During his absence Mr. Rooke will inspect various electrical systems, and more particularly the working of turbine engines as compared with the system of reciprocating engines at present used by the Council. Amongst the other toasts honoured was that of Mr. Donohue, assistant electrical engineer, who will discharge Mr. Rooke's duties during his absence.

Mr. R. J. ROBERTS, of Merthyr Tydvil, has been appointed junior charge engineer at the Cheltenham Corporation Electricity Works.

The position of meter inspector to the Croydon Electricity Department has been filled by Mr. JOSEPH H. BRYAN, of Messrs. Ferranti, Ltd.

**Tramway Officials.**—The Gloucester City Council, on November 29th, appointed Mr. LEONARD JOHNSTON, of Blackburn, as general manager of the tramways, at a salary of £250 per annum, rising by £25 a year to £300. An amendment favouring the amalgamation of the offices of electrical engineer and tramway manager was rejected.

Mr. HY. MOZLEY, the general manager of the Burnley Corporation Electric Tramways, at a smoking concert last week, presented the medals to the members of the Tramways Athletic Club having the best batting and bowling averages.

**General.**—Mr. W. H. BECK, M.I.M.E., F.C.I.P.A., 115 and 117, Cannon Street, E.C., announces that he has admitted as partners in his business of consulting engineer and patent agent his former manager, Mr. STEPHEN EDWARD GUNYON, and his son Mr. ALEXANDER EDWARD BECK, A.M.I.M.E., consulting engineer. The business will be carried on in future under the style of W. H. Beck and Co.

Mr. J. H. HARWOOD has resigned his position with Messrs. Masson, Scott & Co., of Fulham, and has commenced business on his own account as a consulting engineer at Crosby Buildings, Great St. Helens, E.C.

Mr. GEORGE A. GOODWIN, M.I.C.E. Whitworth Scholar and Past-President of the Society of Engineers, has removed his offices from 28, Victoria Street, to 25, Victoria Street, Westminster, where he practises as a consulting engineer and technical expert.

Mr. GEO. H. CUTBUSH, who has been for over five years as assistant in the mains and stations department of the Charing Cross, West End and City Electric Co., is leaving London on December 9th for Glasgow to take up the assistant editorship of the *Motor World and Industrial Vehicle Review*. Mr. Cutbush has long been interested in the motor industry, and is a well-known contributor to automobile journals.

Mr. W. T. BARKER has recently retired from the office of telegraph superintendent at Chester post office. He was for 36 years at Northampton prior to his going to Chester four years ago. He commenced his career with the Electric and International Telegraphic Co. in the sixties, and was taken over at the time of the transfer by the Government.

On Friday, 24th ult., Mr. B. HEYWOOD CLAXTON was entertained at dinner at the Trocadero by some of his old colleagues, and was presented with a silver tray on the occasion of his retirement from the position of superintendent of the North-Western Province of the National Telephone Co., which position he has held since May, 1893. Mr. Claxton is one of the pioneers of the telephone industry in this country, having been engaged in the Telephone Service upwards of 26 years, a period which covers the whole telephone development in the United Kingdom. He inaugurated the system in Liverpool in 1879; he was the first to employ female operators (these now number about 7,500) in telephone exchanges; under his auspices the first multiple switchboard in Europe was installed in Liverpool in 1884, and the first dry core paper cable in the United Kingdom was laid in the Mersey Tunnel. He leaves the management of the Province with a large system comprising over 53,000 telephones and a staff of some 2,300, and his experience in seeing a staff grow to its present dimensions must be unique. Mr. Claxton is well known in Liverpool and district, and on his retirement has been made a member of the Lancashire and Cheshire Local Board of the National Telephone Co.

Mr. M. M. GILLESPIE, until recently a prominent member of the staff of the British Westinghouse Electric and Manufacturing Co., was on Friday last entertained to a complimentary dinner given at the Midland Hotel, Manchester, by his old friends and colleagues in the firm, as a mark of the esteem in which he was always held. The proceedings, which were of an informal nature, bore ample witness to the popularity of a gentleman who has been associated for over 17 years with the Westinghouse Companies on both sides of the Atlantic. In future Mr. Gillespie will be found at his offices, Amberley House, Norfolk Street, Strand, W.C., where he will represent, among other firms, Messrs. Browett, Lindley & Co., for London and the South and West of England.

The *Daily Mail* says that since leaving Liverpool, on October 3rd, Mr. J. R. INGRAM, a traveller for the Imperial Electric Co., has not been seen or heard of. He was on his way to Birmingham.

Mr. W. E. WHITE, of Brighton, has been appointed by the Electric Supply Committee of Marylebone Borough Council, to deal with consumers' accounts generally, and more particularly in connection with the tariff of charges to consumers.

It is reported that Mr. CHARLES T. YERKES is lying at the point of death at the Waldorf-Astoria Hotel, in New York.

The *Daily Telegraph* says that Mr. W. T. SMITH, who has for many years had charge of special telegraphic arrangements throughout the country, including all the recent Royal tours in Ireland, has been appointed by the Postmaster-General telegraphic traffic manager, in succession to Mr. Newlands.

Mr. W. L. SPENCE, A.M.I.C.E., M.I.M.E., was the recipient on Friday, December 1st, of a presentation from the employés of the British Electric Plant Co., Ltd., Alloa, on the occasion of his retirement from the managing directorship of the company. The testimonial was subscribed to by every employé at the works; it took the form of a large combined filing and card indexing cabinet, and a framed photograph of the staff and workmen. The presentation took place at a smoking concert in the Crown Hotel, Alloa, a large number of the employés being present. Mr. Spence is now practising as a consulting electrical and mechanical engineer in Glasgow.

**Obituary.**—The death is reported of Sir CLINTON EDWARD DAWKINS, K.C.B., in his 46th year. He had had a distinguished career in connection with Government finance, which he relinquished in 1900 to become a partner in Mr. Pierpont Morgan's firm. In this capacity he was interested in several electric traction schemes, and gave evidence before a Parliamentary Committee in support of them. His career is described in the *Times* as "one of the most varied and successful of modern times," but his "swift succession of high and responsible posts was too much for him," and "his heart began to fail a year or two ago."

The death occurred on November 30th of Sir Henry C. Fischer C.M.G., late Controller of Telegraphs, in his seventy-third year. According to an account of his life in the *Times* of Saturday last, Sir Henry entered the Hanoverian Government telegraph service in 1852. He came to England in 1856, and entered the service of the Electric and International Telegraph Co. He also became superintendent of that company's foreign department, and the London inland branch was placed under his care in 1860. At the transfer of the telegraph to the State in 1870, he was deputed by the Postmaster-General to organise the staff and other arrangements of the Central Telegraph Office of the General Post Office, and he was for many years controller of the department before his retirement in February, 1898. In 1877 he went with Sir Wm. Preece on a special mission to America to report on the American telegraph system. He was a British delegate to several international telegraph conferences. Upon his retirement in 1898, he received a knighthood; he became a Companion of the Order of St. Michael and St. George two years earlier. Important foreign decorations were also conferred upon him. Sir Henry was a director of the Eastern Telegraph Co.

## NEW COMPANIES REGISTERED.

**H. E. Steel, Ltd.** (86,628).—This company was registered on November 27th, with a capital of £10,000 in £1 shares, to carry on the business of electrical, automobile and general engineers, manufacturers of and agents for and dealers in motors and cycles, coach-builders, public carriers, automobile, omnibus and public carriage manufacturers, agents, dealers and proprietors, electric wiring and electrical appliance manufacturers, &c. The first subscribers (each with one share) are:—H. E. Steel, Regent Street, Cheltenham, electrician; Mrs. M. R. Steel, Regent Street, Cheltenham; H. Ripley, J.P., Ashley Manor, Cheltenham; C. H. Loveridge, 12, Oxford Place, Cheltenham, private secretary; H. E. Ripley, Ashley Manor, Cheltenham, engineer; R. L. Wood, Lloyd's Bank Chambers, Cheltenham, solicitor; and W. Jopp, New Club, Cheltenham, civil engineer. No initial public issue. H. Ripley is the first chairman, and H. E. Steel and R. E. Ripley are the first managing directors. Remuneration of H. E. Steel as managing director, £3 per week; a bonus of 20 per cent. of the net profits, after a dividend of 5 per cent. has been paid, is to be divided between the managing directors; remuneration of ordinary directors as fixed by the company. Registered office, 27, Regent Street, Cheltenham.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Mexico Electric Tramways, Ltd.** (56,932).—This company's annual return was filed on October 17th, when the entire capital of £1,000,000 in 500,000 ordinary and 500,000 preference shares of £1 each had been taken up, £500,000 being paid on the preference, and £500,000 considered as paid on the ordinary. Debentures created prior to 1900, £400,000. Debentures created since 1900, £500,000 (issued, £200,000).

## ELECTRICITY SUPPLY ACCOUNTS.

### Bristol Municipal Electricity Supply.

The returns of the Bristol electricity supply undertaking for the past year contain a gratifying record of progress, which, especially as regards the output for power purposes, is very marked. During the year some 1,000 H.P. of motors was added, and over half a million extra power units were supplied by the department, whose output reached 5,217,528 units.

The recent development of the undertaking has coincided largely with the extension of the Avonbank generating station, where it may be noted turbo-generating plant of large capacity has recently been installed.

Two 1,000-KW. 6,600-volt three-phase turbo-generators have been provided for operating motor-generators at the Temple Back Works and outlying sub-stations, especially for power supply purposes, and the latter works has been, to some extent, remodelled by the disposal of the smaller and more inefficient plant.

The respective works costs of the two stations are as under:—

| | Temple Back. | Avonbank. | Combined system. |
|---|---|---|---|
| Coal ... ... | ·527d. | ·391d. | ·442d. |
| Oil, &c. ... ... | ·052d. | ·043d. | ·047d. |
| Wages ... ... | ·255d. | ·233d. | ·290d. |
| Repairs, &c. ... | ·147d. | ·126d. | ·190d. |
| Total ... ... | ·982d. | ·793d. | ·969d. |

The coal bill per unit shows a reduction of 25 per cent. on the previous year, and with other economies in working allows of a net profit of over ½d. per unit, a figure which has not been reached since 1898, when the price was 6d. per unit.

The prices charged are:—Private lighting, 3½d. (day) and 4½d. (night) per unit; power, 1½d. to ⅔d. per unit; public arcs, £21, £19 and £14 10s. per annum. The chief engineer is Mr. H. Faraday Proctor.

General Statement.

| For year ending March 25th ... ... | 1905. | 1904. |
|---|---|---|
| Total capital expended ... ... ... | £590,984 | £542,244 |
| Number of units sold— | | |
| Private supply { Lighting ... ... | 2,620,387 | 2,461,458 |
| Private supply { Power ... ... | 1,759,085 | 1,224,733 |
| Public lighting ... ... ... | 838,056 | 613,313 |
| Total number of units sold ... | 5,217,528 | 4,299,504 |
| Equivalent No. of 8-C.P. lamps connected | 274,176 | 234,098 |
| H.P. of motors connected ... ... ... | 3,213 | 2,306 |
| Number of public lamps ... ... | { 677 arc. 9 inc. | 674 arc. 8 inc. |
| Maximum load in KW. ... ... ... | 4,284 | 3,444 |
| Revenue account— | | |
| Gross revenue ... ... ... | £69,687 | £61,372 |
| „ expenditure ... ... ... | £31,935 | £29,841 |
| „ profit ... ... ... ... | £37,752 | £31,531 |
| Average price obtained per unit— | | |
| Private supply { Lighting... ... | 4·18d. | 4·20d. |
| Private supply { Power ... ... | 1·24d. | 1·30d. |
| *Public lighting ... ... ... | 3·40d. | 3·48d. |

* Includes cost of attendance and repairs, which is repaid to the department.

Revenue Account for Year 1905.

| | |
|---|---|
| Gross revenue... ... ... | £69,687 = 3·2d. per unit. |
| Works and distribution costs (including public lighting) | £23,035 = 1·06d. „ |
| Total working costs ... ... | £37,752 = 1·74d. „ |

Profit Statement, 1905.

| | |
|---|---|
| Interest on loans, &c. ... ... ... ... | £17,168 |
| Sinking fund ... ... ... ... ... | £9,723 |
| Net profit on year's working ... ... ... | £10,861 |
| Gross profit ... ... ... ... | £37,752 |

From the foregoing it will be gathered that the undertaking is repaying the forward policy adopted by the department, and after meeting ordinary financial charges, a handsome surplus of £10,861 remains on the year's working. The latter, together with £2,408, being the last year's balance and accrued interest, was allocated as follows:—Reserve fund, £5,561; depreciation and contingency account, £4,526; interest and dividends account, £2,230, leaving a balance of £952 to be carried forward.

The reserve fund now totals £10,000, and the depreciation account £6,000, while the special expenditure due to the fire of December, 1903, has been paid off with the exception of a small balance which will be otherwise covered.

### Leeds Municipal Electricity Supply.

The Leeds returns, like those of Bristol, show the prominence which motive power supply is attaining, although the total output for all purposes is far greater in the northern city.

The working costs, which have decreased, are always a satisfactory feature of the year's working; the latter, however, despite a large increase in gross profit, resulted in a deficit of some £700 after meeting the heavy financial charges. This deficit was covered by transferring to revenue £1,000 from the redemption fund suspense account, the balance being carried forward.

During the year the units sold and revenue per lamp installed were 20·33 and 5/10·55 as compared with 20·88 and 6/0·59 in the year ending March, 1904. The revenue and units sold per motor H.P. installed were similarly 3/5/8 and 589 units; and 3/18/4 and 732 units respectively.

The prices charged are:—Private lighting, 4d. and 1d. per unit, special scale; power, &c., 2d. to 1½d. with discounts, and public lighting, 1½d. net per unit. The chief engineer is Mr. H. Dickenson.

General Statement.

| For year ending March 25th ... ... | 1905. | 1904. |
|---|---|---|
| Total capital expended ... ... ... | £822,123 | £757,327 |
| Number of units sold— | | |
| Private supply ... ... ... | 4,871,731 | 4,428,657 |
| Public lighting ... ... ... | 217,997 | 177,170 |
| Power and heating ... ... ... | 1,940,953 | 1,665,359 |
| Total number of units sold ... | 7,030,681 | 6,271,186 |
| Equivalent No. of 8-C.P. lamps connected | 362,248 | 307,849 |
| H.P. of motors connected ... ... ... | 3,904 | 2,903 |
| Number of public lamps ... ... ... | 247 | 122 |
| Maximum load in KW. ... ... ... | 5,540 | 5,040 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £84,416 | £75,721 |
| „ expenditure ... ... ... | £28,364 | £26,184 |
| „ profit ... ... ... ... | £56,052 | £49,537 |
| Average price obtained per unit— | | |
| Private ... ... ... ... ... | 3·57d. | 3·56d. |
| Public lighting ... ... ... | 1·25d. | 1·50d. |
| Power and heating ... ... ... | 1·33d. | 1·28d. |

Revenue Account for Year 1905.

| | | | |
|---|---|---|---|
| Gross revenue ... ... ... | £84,416 | = | 2·88d. per unit. |
| Works and distribution costs ... | £19,318 | = | ·66d. „ |
| Total working costs... ... ... | £28,364 | = | ·965d. „ |

Profit Statement, 1905.

| | |
|---|---|
| Interest on loans ... ... ... ... ... | £28,809 |
| Sinking fund... ... ... ... ... | 27,961 |
| Deficit on year's working ... ... ... ... | — 718 |
| Gross profit ... ... ... | £56,052 |

## CITY NOTES.

### Geneva Tramways Co.

The directors' report for the year ending September 30th, 1905, states that the profit and loss account of the Compagnie Genevoise des Tramways Electriques shows a gross profit on working of 469,776·76 fr., and including the credit balance of 56,390·45 fr., brought forward from the previous period, makes a total of 526,167·21 fr., which, after making provision for the necessary contributions to amortisation, renewal and reserve funds, amounting together to 158,030·35 fr., and for sundry expenses 5,518·40 fr., leaves a balance of 362,618·46 fr., out of which a dividend of 1 per cent., amounting to 200,000 fr., has since been paid, leaving a balance of 162,618·46 fr. to be carried forward. Additional rolling stock having become necessary, this balance, together with a further amount from the current year's earnings, has been set aside for this purpose, which will absorb a sum not exceeding 250,000 fr. Of the dividend of 200,000 fr. above referred to, 199,960 fr. have been received by this company in respect of its holding of shares in the Swiss company, as shown in the profit and loss account. The following is an analysis and comparison of the traffics and results for the four years ending December 31st, 1904:—

| Period. | Average kilometres of line in operation. | Total train kilometres including merchandise traffic. | Average train kilometre per day. | Passengers carried. Total. | Average per kilom. of line. | Daily average. | Average per train kilom. |
|---|---|---|---|---|---|---|---|
| 1901 .. | 112·760 | 2,643,331 | 7,242 | 11,360,467 | 100,749 | 31,124 | 4·297 |
| 1902 .. | 124·581 | 3,509,299 | 9,721 | 11,711,974 | 94,010 | 32,443 | 3·337 |
| (361 days) | | | | | | | |
| 1903 .. | 125·313 | 3,831,693 | 10,497 | 12,466,767 | 99,485 | 34,155 | 3·253 |
| 1904 .. | 125·560 | 3,940,593 | 10,796 | 13,928,429 | 110,980 | 38,055 | 3·534 |

| Period. | Gross revenue. Total. | Average per kilom. of line. | Average per train kilom. | Average per passenger gross. | Average fare including baggage. | Average per passenger on merchandise and sundries. |
|---|---|---|---|---|---|---|
| | Fr. | Fr. | Fr. | Fr. | Fr. | Fr. |
| 1901 .. | 1,841,935·60 | 16,335 | ·696 | ·162 | ·156 | ·006 |
| 1902 .. | 1,890,775·15 | 15,177 | ·538 | ·161 | ·155 | ·006 |
| 1903 .. | 1,953,486·25 | 15,589 | ·509 | ·157 | ·150 | ·007 |
| 1904 .. | 2,132,051·55 | 16,980 | ·541 | ·153 | ·144 | ·009 |

| Period. | Gross expenditure. Total. | Average per kilom. of line. | Average per train-kilom. | Average per passenger. | Electric traction expenses. Expenses per train-kilom. | Electric power alone per train-kilom. | Average cost per kw.-hour. | Ratio expenses to revenue. |
|---|---|---|---|---|---|---|---|---|
| | Fr. | Fr. | Fr. | Fr. | Fr. | Fr. | Fr. | Per cent. |
| 1901 | 1,591,692·20 | 14,115·75 | ·602 | ·140 | ·25 | ·11 | ·12 | 86·41 |
| 1902 | 1,745,151·85 | 14,008·17 | ·497 | ·149 | ·231 | ·10 | ·107 | 92·3 |
| 1903 | 1,742,037·45 | 13,901·52 | ·454 | ·140 | ·23 | ·103 | ·104 | 89·18 |
| 1904 | 1,670,441·35 | 13,303·92 | ·423 | ·119 | ·221 | ·101 | ·104 | 78·34 |

| Period. | Profit. Total profit on working. | Ratio of profit to revenue. | Per passenger carried. | Per train-kilom. | On average fare. |
|---|---|---|---|---|---|
| | Fr. | Per cent. | Fr. | Fr. | Fr. |
| 1901 .. | 250,243·40 | 13·59 | ·022 | ·09 | ·016 |
| 1902 .. | 145,623·30 | 7·7 | ·012 | ·041 | ·004 |
| 1903 .. | 211,448·80 | 10·82 | ·017 | ·055 | ·010 |
| 1904 .. | 461,610·20 | 21·65 | ·034 | ·118 | ·025 |

Of the authorised issue of £20,000 prior debentures, £4,000 have been subscribed and issued and subsequently redeemed in accordance with the terms of the supplementary trust deed of August 26th, 1903. Consequent upon the continued inability of the Compagnie Genevoise des Tramways Electriques to pay adequate dividends on its capital with which to meet this company's indebtedness, the revenue account of this company shows a loss for the period of £34,270 18s. 5d., increasing the amount standing to the debit of revenue account to £151,559 12s. 5d., mainly the result of the accumulation of unpaid interest on the debenture issues.

### Aron Electricity Meter.

The report of the directors, to be submitted to the meeting to-day, says that the profit and loss account for the year to September 30th, 1905, after providing for general charges, depreciation and share of expenses and discount on the issue of debentures, shows a net profit of £11,724, making, with the balance of £413 carried forward last year, a total available profit of £12,137. Of this amount there will be set aside for the debenture sinking fund in accordance with the trust deed £2,500, and the directors propose to pay 4½ per cent. on account of the preference dividend in arrear, absorbing £5,620, and to carry forward £4,016. The directors consider this result most encouraging. Trade in Germany and Austria has been very healthy throughout the year. The factories in Schweidnitz and Charlottenburg are also giving every satisfaction. The business in France and England is still in a somewhat unsettled condition; the outlook is, however, distinctly hopeful, and the directors will continue their policy of economy and care. Two directors, Lieut.-Col. R. E. Crompton, C.B., and Mr. S. Barclay Heward, retire by rotation, but offer themselves for re-election.

### The Cape Electric Tramways.

The ninth ordinary general meeting of this company was held on Wednesday at London Wall Buildings, London Wall, Col. Sir Charles Euan-Smith presiding. In moving the adoption of the report, the chairman said that the falling off in receipts was due to the prevalent commercial depression all over the country. The hope expressed last year that the prospects would improve had not been realised, and he was compelled to tell them that, since the date of the balance-sheet, there had been a further decrease in the receipts. Much of it was due to the interruption caused by the renewal work, which was now being rapidly pushed forward. With regard to the dividends, the former large dividends were never issued without a warning that the company could not continue to pay such high dividends—that they must be exceptional. That warning was issued in 1900 and in the following years up to 1903, and now that period of prosperity had been succeeded by a period of commercial depression. The question of the lease of the Consolidated Tramways had been settled at the two extraordinary general meetings. The lease expired on the 31st of this month, and after that date they would have no further connection with that company. The general renewal work and the extensions of their line had been carried out by the money obtained on loan, their reserve fund being invested in their undertaking. In June last the company suffered a serious loss by the gas explosion which destroyed a considerable part of their line, and now they were seeking legal remedy for the damage sustained. The severe floods and violent storms in Port Elizabeth and other places had also seriously interfered with them. The question of the expropriation of the Sea Point Railway was *sub judice*, so that he could say nothing about it, except that the directors considered it to be a very valuable part of their property, and would endeavour to get the best terms for the shareholders. In conclusion, he remarked that prosperity in the Transvaal, and the abundant rains which had fallen, would both tend to make an improvement in business in the future.

Mr. Ludwig Breitmeyer, in seconding the motion, said that all the company could do was to provide an efficient service for the public; if the public did not take advantage of it, it was not their fault.

Replying to shareholders questions, Mr. Breitmeyer said that the lines of the Consolidated Tramways would be handed back to them in good repair.

The report was then adopted, and the directors were re-elected.

**Prospectus.**—*British Columbia Electric Railway Co.*—This company has this week been inviting applications for an issue of 185,000 of 5 per cent. cumulative perpetual preference shares of £1 each, at the price of £1 0s. 10d. per share. The company has outstanding £100,000 6 per cent. two-year promissory notes, and it is for retiring these notes and to provide funds for the further capital extensions required by the business that the present issue has been made.

**Bayliss, Jones & Bayliss.**—The directors recommend a dividend of 5 per cent. on the ordinary shares for the year ended September 30th. The sum of £6,450 is placed to depreciation reserve account, leaving £662 to be carried forward.

**Stock Exchange Notices.**—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Bombay Electric Supply and Tramway Co., Ltd.—60,000 6 per cent. cumulative preference shares of £10 each, Nos. 1 to 60,000; and £600,000 4½ per cent. debenture stock.

The Committee has ordered the undermentioned securities to be quoted in the Official List:—

Oriental Telephone and Electric Co., Ltd.—£100,000 4 per cent. redeemable debenture stock.

**Mersey Railway Co.**—At a meeting of debenture stockholders held last week, a resolution approving the proposed Bill with reference to the extension of the period during which the payment of interest on the company's debenture stocks (other than the new debenture stock) shall be contingent on the revenue available therefor, in each separate year, was adopted. Mr. James Falconer presided, and gave an exhaustive account of the company's financial position and the results of the working of the line by electric traction.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| Locality. | Fortnight ended. | Receipts for the fortnight. £ | Receipts for the fortnight. £* | No. of wks. | Total to date. £ | Total to date. £* | Route miles open. | * |
|---|---|---|---|---|---|---|---|---|
| Aberdeen | Dec. 2 | 2,318 | + 124 | 27 | 38,831 | — 1,412 | .. | .. |
| Ayr | Nov. 25 | 350 | + 5 | 27 | 9,642 | — 142 | 8 | .. |
| Bath | ,, 29 | 1,172 | + 197 | 48 | 32,830 | + 2,153 | 13 | .. |
| †Birkenhead | ,, 26 | 900 | + 26 | 34 | 35,786 | — 758 | 13·5 | .. |
| Blackburn | ,, 29 | 1,704 | + 271 | 35½ | 35,185 | + 1,324 | 13·5 | .. |
| Blackpool Corp. | ,, 30 | 528 | — 9 | 35 | 44,099 | + 1,784 | 11·87 | .. |
| ,, —Fleetw'd | Dec. 2 | 310 | — 42 | 22 | 19,507 | — 1,099 | .. | .. |
| ,, —Lytham | Nov. 30 | 280 | + 27 | 4 | 623 | + 17 | 7½ | .. |
| Bolton | Dec. 3 | 3,568 | + 273 | 36 | 69,417 | + 2,749 | 26 | + 1 |
| Bournemouth | Nov. 29 | 2,341 | + 893 | 34½ | 50,065 | + 9,914 | 17·4 | + 7½ |
| Bradford | Dec. 2 | 7,936 | +1,087 | 35 | 155,740 | — 5,880 | 53 | .. |
| Brighton | ,, 3 | 1,463 | + 74 | 36 | 37,508 | .. | 9·5 | .. |
| Bristol | ,, 1 | 8,703 | — 174 | .. | .. | .. | 28·5 | .. |
| **Brit. Elec. Trac. Co.** | | | | | | | | |
| Airdrie | Nov. 24 | 400 | + 25 | 47 | 9,670 | + 155 | 8·5 | .. |
| Barnsley | ,, 24 | 305 | — 10 | ,, | 7,565 | — 336 | 3 | .. |
| Barrow | ,, 24 | 398 | + 25 | ,, | 11,351 | + 2,177 | 5·37 | .. |
| ‡Birmingham (City) | ,, 24 | 9,966 | — 153 | ,, | 252,087 | + 267 | 14·5 | .. |
| Birmingham (Mid.) | ,, 24 | 2,635 | — 126 | ,, | 74,329 | — 35 | 12·25 | .. |
| Devonport | ,, 24 | 745 | — 132 | ,, | 21,632 | — 3,309 | 8·85 | .. |
| Dudley—Sto'rb'ge | ,, 24 | 1,605 | + 128 | ,, | 42,241 | + 1,487 | 21·25 | .. |
| Gateshead | ,, 24 | 1,829 | + 75 | ,, | 43,375 | + 870 | 11·25 | .. |
| Gravesend, N'fleet | ,, 24 | 282 | + 18 | ,, | 10,902 | — 924 | 6·5 | .. |
| Gr'n'k, Pt. Glsgw | ,, 24 | 1,166 | + 152 | ,, | 30,356 | + 3,286 | 7·25 | .. |
| Hartlepool | ,, 24 | 475 | + 3 | ,, | 12,563 | — 1,201 | 6·72 | .. |
| Kidderminster | ,, 24 | 174 | — 12 | ,, | 5,715 | — 334 | 4·5 | .. |
| Leamington | ,, 24 | 251 | + 72 | 19 | 3,638 | + 1,316 | .. | .. |
| Merthyr | ,, 24 | 340 | — 36 | 47 | 8,917 | — 508 | 2·9 | .. |
| ‡Metropolitan | ,, 24 | 4,888 | +1,704 | ,, | 125,465 | +53,620 | .. | .. |
| Middleton | ,, 24 | 560 | + 44 | ,, | 15,953 | + 671 | 8·5 | .. |
| Oldham — Ashton | ,, 24 | 1,079 | + 96 | ,, | 26,289 | + 627 | 9·13 | .. |
| Peterborough | ,, 24 | 188 | — 10 | ,, | 6,325 | — 665 | 5·31 | .. |
| Potteries | ,, 24 | 8,527 | + 134 | ,, | 80,397 | + 660 | 29 | .. |
| Rothesay | ,, 24 | 80 | + 10 | ,, | 9,464 | + 2,674 | 2·75 | .. |
| Sheerness | ,, 22 | 99 | — 10 | ,, | 3,299 | + 279 | 2·5 | .. |
| Southport | ,, 24 | 428 | — 24 | ,, | 14,724 | — 534 | 8·17 | .. |
| South Staffs. | ,, 24 | 1,556 | + 274 | ,, | 34,793 | + 1,496 | 13·87 | .. |
| Swansea | ,, 24 | 1,422 | + 497 | ,, | 33,985 | + 8,603 | 5·5 | .. |
| Taunton | ,, 24 | 83 | + 14 | ,, | 1,972 | — 234 | 1·5 | .. |
| Tynemouth | ,, 24 | 327 | — 21 | ,, | 12,210 | — 1,609 | 3·75 | .. |
| Weston-s-Mare | ,, 22 | 50 | — 15 | ,, | 6,725 | + 593 | 3 | .. |
| Wolverhampton D. | ,, 24 | 765 | + 78 | ,, | 18,636 | + 274 | 14·75 | .. |
| Worcester | ,, 24 | 446 | — 46 | ,, | 14,263 | + 389 | 5·75 | .. |
| Wrexham | ,, 24 | 165 | + 1 | ,, | 4,736 | — 880 | 4 | .. |
| Yorks. Wool. Dist. | ,, 24 | 1,390 | + 475 | ,, | 31,166 | + 3,826 | 17 | .. |
| Burnley | Dec. 2 | 2,092 | + 247 | .. | .. | .. | 7·5 | .. |
| Burton-on-Trent | ,, 3 | 495 | — 26 | 35 | 11,168 | — 1,365 | 8·5 | .. |
| Bury | Nov. 26 | 1,426 | .. | 34 | 25,409 | .. | 10·5 | .. |
| Cardiff | ,, 25 | 3,410 | — 25 | 34 | 71,106 | + 109 | 15·8 | .. |
| Carlisle | Dec. 2 | 301 | — 24 | 48 | 8,803 | — 627 | .. | .. |
| Chatham and Dist. | Nov. 30 | 1,041 | + 159 | 48 | 31,484 | + 3,379 | 9·3 | + ·8 |
| Colchester | ,, 29 | 268 | — 16 | 18 | 3,600 | .. | 7 | .. |
| Cork | ,, 30 | 769 | + 4 | 48 | 23,145 | + 634 | 9·89 | .. |
| Darlington | Dec. 2 | 394 | + 41 | 35 | 7,261 | .. | 4·87 | .. |
| Darwen | ,, 1 | 450 | + 53 | 35 | 8,597 | + 432 | 4·36 | .. |
| Dover | ,, 2 | 345 | + 46 | 35 | 8,249 | — 40 | 4·75 | + 1½ |
| Dublin | ,, 1 | 8,852 | + 470 | .. | 112,054 | — 618 | 48·5 | + 1·5 |
| Dundee | Nov. 29 | 1,755 | + 200 | 28 | 25,889 | + 1,477 | 12·5 | .. |
| East Ham | Dec. 2 | 1,465 | + 346 | 35 | 29,302 | + 3,858 | 8 | + 1½ |
| Glasgow | ,, 2 | 29,623 | +3,210 | 26 | 406,806 | +21,063 | 76 | + 2·5 |
| Gloucester | Nov. 29 | 423 | + 40 | 35 | 10,666 | .. | 9 | .. |
| Halifax | ,, 22 | 2,642 | + 289 | 34 | 55,198 | + 3,090 | 37 | + 2·5 |
| Huddersfield | Dec. 2 | 2,625 | + 365 | 35 | 48,229 | + 1,894 | 28 | .. |
| Hull | ,, 2 | 4,265 | + 156 | 35 | 78,289 | + 722 | 13 | .. |
| Ilford | ,, 2 | 745 | + 92 | 35 | 17,008 | + 425 | .. | .. |
| Ilkeston | Nov. 29 | 200 | + 19 | 35 | 4,225 | — 794 | 3·5 | .. |
| Ipswich | Dec. 2 | 607 | + 23 | 35 | 15,754 | — 1,831 | 10·5 | .. |
| Isle of Thanet | ,, 2 | 455 | .. | 48 | 30,633 | — 3,259 | .. | .. |
| Kirkcaldy | Nov. 29 | 376 | — 25 | .. | .. | .. | 7·5 | .. |
| Lan'kshire Trm. Co. | ,, 30 | 1,576 | + 412 | 48 | 36,004 | + 4,645 | 12·5 | + 3·9 |
| Leeds | ,, 25 | 10,790 | + 729 | 34 | 208,095 | + 4,450 | 89·5 | + 8 |
| Leicester | Dec. 2 | 3,813 | + 679 | 48 | 99,430 | +29,615 | .. | .. |
| Liverpool | Nov. 25 | 19,726 | + 378 | 47 | 496,316 | + 8,765 | 104 | + 1 |
| L.C.C. | ,, 18 | 24,860 | +2,227 | 33 | 496,703 | +68,818 | 51 | + 4½ |
| Lowestoft | Dec. 2 | 268 | + 6 | 9 | 1,387 | — 26 | 3·5 | .. |
| Manchester | ,, 2 | 24,184 | +2,670 | 35 | 454,652 | +19,709 | .. | .. |
| Newcastle | ,, 2 | 6,912 | — 118 | 35 | 133,860 | + 2,874 | .. | .. |
| Newport | Nov. 25 | 1,024 | + 35 | 8 | 4,277 | + 305 | 14·5 | + 1·5 |
| Oldham | Dec. 3 | 3,126 | + 537 | 36 | 59,353 | +15,274 | 23·75 | + 1·6 |
| Plymouth | .. | .. | .. | .. | .. | .. | .. | .. |
| Pontypridd | ,, 2 | 267 | .. | 35 | 5,745 | .. | 3·5 | .. |
| Portsmouth | ,, 2 | 2,690 | + 159 | 35 | 72,788 | + 1,116 | 14·5 | .. |
| Preston | Nov. 29 | 1,096 | .. | .. | .. | .. | .. | .. |
| Reading | ,, 30 | 1,111 | + 34 | 35 | 22,449 | — 498 | .. | .. |
| Rochdale | Dec. 2 | 1,492 | + 797 | 35 | 27,446 | +19,543 | 21·3 | + 5·8 |
| Salford | Nov. 27 | 8,168 | +1,118 | 35 | 150,280 | + 8,093 | .. | .. |
| †Scarborough | ,, 25 | 49 | .. | 46 | 7,735 | .. | 4·5 | .. |
| Sheffield | Dec. 3 | 9,495 | +1,013 | 36 | 177,636 | + 8,588 | 35·75 | + 1·5 |
| †Southampton | Nov. 22 | 775 | — 20 | 7½ | 6,550 | — 507 | 6 | .. |
| Southend-on-Sea | ,, 29 | 446 | + 54 | 35 | 14,264 | + 711 | .. | .. |
| Stalyb'dge, Hyde, &c. | ,, 25 | 1,145 | + 406 | 34 | 22,231 | .. | 21 | .. |
| Stockport | ,, 24 | 1,427 | + 559 | 34 | 26,124 | + 6,017 | 15·5 | + 4 |
| Sunderland | Dec. 3 | 2,342 | + 198 | 35 | 47,188 | + 1,560 | .. | .. |
| Swindon | Nov. 29 | 309 | + 41 | 35 | 7,010 | .. | 4·4 | .. |
| Tyneside | ,, 29 | 633 | + 17 | 48 | 19,751 | + 1,066 | 8·87 | .. |
| Warrington | ,, 23 | 640 | + 48 | 34 | 11,624 | + 575 | 6·37 | + ·25 |
| West Ham | ,, 30 | 3,481 | +1,580 | 35 | 63,037 | +26,616 | 13·25 | + 3·4 |
| Wolverhampton | ,, 29 | 1,423 | .. | .. | .. | .. | 10 | .. |
| Cen. London Rly. | Dec. 2 | 14,145 | — 21 | 22 | 138,123 | — 961 | 6 | .. |
| City & S. Lon. Rly. | ,, 3 | 6,269 | + 18 | 22 | 58,815 | + 300 | 6·25 | .. |
| Dublin-Lucan Rly. | ,, 1 | 171 | — 4 | 22 | 2,798 | — 26 | 7 | .. |
| G. N. and City Rly. | ,, 2 | 3,612 | + 568 | 22 | 34,143 | + 7,666 | 3·5 | .. |
| L'pool Overh'd Rly. | ,, 3 | 2,752 | — 103 | 22 | 34,741 | — 1,545 | 6·57 | .. |
| Mersey Railway | ,, 2 | 3,305 | + 83 | 22 | 34,666 | + 2,000 | 4·5 | .. |

* Compared with the corresponding period of 1904. † One week only.

‡ Includes horse and other receipts.

## STOCKS AND SHARES.

Wednesday evening.

Money rather than politics is the dominant force in the Stock Exchange markets. Russia remains a powerful deterrent upon the course of business, but her influence is counteracted to a very large extent by the abundance of cheaper money—or credit, as the financial purists prefer to say. Investment sections meet with a fair measure of support, but the Electricity departments again display pronounced weakness in the shares of Supply companies. Railway stocks are steady, and telegraphs tend to improve.

Of the various new issues offered to the public during the past few days, the British Columbia Electric Railway Preference shares are amongst the best class. They carry a perpetual cumulative interest of 5 per cent., and were offered at a premium of 10d. apiece, which, it might be thought, would not add attraction to the shares in the eyes of the investor. But so far as security goes, they would appear to be well covered, and when the shares are in permanent hands they may become more valuable.

Both the new electric and motor cab companies estimated splendid dividends in their prospectuses, but whether fulfilment, in its literal sense, will wait on prophecy, is open to doubt. The cautious capitalist should want to know a great deal more than is at present ascertainable about the cost of serviceable motors, capacity of tires and probable daily takings—to mention only three points—before putting money into such ventures. By waiting he may lose a golden opportunity for getting in on the ground-floor. Some golden opportunities, based on estimates in prospectuses, are worth losing.

Meanwhile, London Motor-Omnibus shares have recovered to 2¼, while District Motor-'Bus are 1 7/16, and the premium on Motor-'Bus shares continues at 3s. 9d. London Road Car and London General Omnibus issues are both very weak. The latter stands at 104, a fall of 20 points in 10 weeks.

Home Railway stocks gave way in some cases under the severe pressure of sales that was felt all round the Stock Exchange last Monday, and Metropolitan Consolidated at 89 has failed to make up its loss. Districts are 37¾. The Metropolitan is again reducing some of its fares, but it is a great pity that the electrification of the line to Hammersmith is not pushed forward, since the District must certainly be reaping advantage from the delay. City and South London at 47 is firm, and market authorities guess the dividend for the current half-year as likely to be at the rate of 1¾ per cent., the same as it was for the corresponding period of 1904. This is the first Home Railway dividend estimate we have heard this season. Central Londons will, no doubt, get the usual rates: 2 per cent. on the Preferred and Ordinary, and 4 per cent. on the Deferred—actual money in each case.

Several Argentine traction issues are easier. Anglo-Argentine Ordinary shed ¼, and so did Belgranos, the traffics seeming to disappoint some of the shareholders. Traction varieties, on the whole, are uninteresting, so far as movements in price are concerned. Potteries Preference rose ¼, to their par value of £10, and if there were a freer market in them they might go better as a good 5 per cent. investment. Westinghouse Preference are nominally rather better at 2¼, but the report, expected last month, has not appeared yet. In view of rumours regarding a possible reconstruction of the company, the tardiness displayed with regard to the issue of the report has called forth comment none too complimentary in tone. The latest that we hear is to the effect that the document will be out on Saturday.

The slight fall of 5s. in General Electric Preference would scarcely call for notice were it not that several inquiries have been made within the last few days for a quotation of the Ordinary shares. The price is supposed to be somewhere between 9 and 10, but possibly a buyer might find no great difficulty in dealing at 9. We repeat the word "possibly."

Declines and falls disfigure the list of shares in the Supply companies serving the metropolis. The threatened competition of the London County Council has grown no less formidable by the resignation of Mr. Balfour, and consequent unsettlement of home politics. Dealers in the Electricity Supply market are dropping the lower quotation in their sets of prices, and it becomes more difficult to realise any substantial number of shares. Kensington Ordinary are 5s. better at 11¼, and the provincial list is exceedingly steady. But weakness is apparent in Chelseas (which are down to 5½), Charing Cross, Westminster Preference, Metropolitan Ordinary and Preference, and Bromptons. City Lights are unaltered; the question is raised in some quarters as to whether the company has been equitably treated by the Corporation.

Brush Ordinary are ¼ easier, and British Insulated fell ¼ to 6⅜; but both the Debenture stocks of the Brush Co. have improved.

Russian sensations may prove valuable to the Great Northern Telegraph Co., whose lines run to St. Peterburg, and the price of the shares hardened 10s. to 36. The cutting off of telegraphic communication is considered unlikely to do material damage to the company's business. Anglo-Americans fell upon a rumour, promptly denied, that the board contemplated adding another cable to their trans-Atlantic service. The Deferred shows a loss of ⅜ at 17¼. Direct United States shares are ½ up, and two or three *ex* dividend markings have left no impression upon quotations. National Telephone Preferred fell ½ to 111, but the alteration was not connected with the chance of a Radical Government. Monte Video Telephone and United River Plate Telephone shares are both better.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last four years. 1902. | 1903. | 1904. | 1905. § | Closing Quotations Nov. 29th. | Closing Quotations Dec. 6th. | Business done week ended Dec. 6th, 1905. Highest | Lowest. | Rise + or Fall — |
|---|---|---|---|---|---|---|---|---|---|---|---|
| £ 34,800 | African Direct Telegraph, 4 % Debs... .. .. | 100 | 4 % | 4 % | 4 % | 4 % | 99—102 | 99 —102 | .. | .. | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | Nil | Nil | Nil | .. | 3¾— 4¼ | 3¾ — 4¼ | .. | .. | .. |
| 119,700‖ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | Nil | Nil | Nil | 5 % | 85 — 90 | 85 — 90 | .. | .. | .. |
| 763,580 | Anglo-American Telegraph .. .. .. | Stock | 60/6 | 61s. | 23⅝ | 29s. § | 62 — 64 | 62 — 64 | 62⅛ | 62 | .. |
| 3,118,210 | Do. do. do. 6 % Pref. .. .. | Stock | 6 % | 6 % | 5½ % | 58s. § | 109¼—110¼ | 109¼—110¼ | 110⅛ | 109¼ | .. |
| 3,118,210 | Do. do. do. Deferred .. .. | Stock | 1/- | 2s. | Nil | .. | 17⅞— 17¾ | 17⅞— 17¾ | 17 1/16 | 17 1/16 | — ⅛ |
| 50,000 | Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red. | 100 | .. | .. | .. | .. | 102 —104 | 102 —104 | .. | .. | .. |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 .. .. .. | 5 | 6 % | 7 % | 8 % | .. | 7⅞— 7⅞ | 7⅞— 7⅞ | .. | .. | .. |
| 1,932,856‖ | Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red. | Stock | 4 % | 4 % | 4 % | 4 % | 96 — 98 | 96 — 98 | 97¼ | 96¾ | .. |
| 16,000 | Cuba Telegraph .. .. .. .. .. | 10 | 6½% | 10 % | 5 % | 5 %§ | 8¾— 9¼ | 8¾ — 9¼ | .. | .. | .. |
| 6,000 | Do. 10 % Pref. .. .. .. .. | 10 | 10 % | 5 % | 10 % | 10 %§ | 17 — 18 | 17 — 18 | .. | .. | .. |
| 12,931 | Direct Spanish Telegraph, Ord. .. .. .. | 5 | 4 % | 4 % | 4 % | 4 %§ | 3⅞— 3⅞ | 3⅞— 3⅞ | .. | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. .. | 5 | 10 % | 10 % | 10 % | 10 %§ | 9¼— 9¾ | 9¼— 9¾ | .. | .. | .. |
| 80,000 | Do. do. 4½ % Debs. .. .. | 50 | 4½% | 4½% | 4½% | 4½%§ | 100 —103 | 100 —103 % | .. | .. | .. |
| 60,710‖ | Direct United States Cable .. .. .. | 20 | 3½% | 3 % | 3½% | 3 %§ | 13½— 13⅝ | 13¾— 14¼ | 14⅛ | 13½ | + ⅛ |
| 74,500 | Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R. | 100 | 4½% | 4½% | 4½% | 4½% | 100½—102½ | 100½—102½ | 101 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock .. .. | Stock | 7 % | 7 % | 7 % | 5 %§ | 144 —147 | 144 —147 | 146½ | 145 | .. |
| 2,000,000 | Do. 8½ % Pref. Stock .. .. .. | 100 | 8½% | 8½% | 8½% | 8½%§ | 89½— 91½ | 89½— 91½ | 91 | 89½ | .. |
| 1,896,814 | Do. 4 % Mort. Deb. Stock Red. .. | Stock | 4 % | 4 % | 4 % | 4 %§ | 106 —108 | 106 —108 | 107⅛ | 106⅞ | .. |
| 300,000 | Eastern Extension, Australiasia, and China Tele. | 10 | 7 % | 7 % | 7 % | 6 %§ | 14½— 15 | 14½— 15 | 14 3/16 | 14 1/16 | .. |
| 602,400 | Do. 4 % Deb. Stock .. .. .. | Stock | 4 % | 4 % | 4 % | 4 %§ | 106 —108 | 106 —108 | 107⅛ | 107 | .. |
| 800,000 | East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909 | 100 | 4 % | 4 % | 4 % | 4 % | 99½—101½ | 100 —102 | .. | .. | + ½ |
| 200,000‖ | Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | 4 % | 4 % | 4 % | 4 % | 100 —102 | 100 —102 | .. | .. | .. |
| 180,887 | Globe Telegraph and Trust .. .. .. | 10 | £3 | 5½% | 5⅞% | 5 % | 10½— 10⅝ | 10½— 10⅝ | 10 1/16 | 10 1/16 | .. |
| 180,887 | Do. do. 6 % Pref. .. .. .. | 10 | 6 % | 6 % | 6 % | 6 % | 14⅜— 14⅝ | 14⅜— 14⅝ | 14 7/16 | 14⅜ | .. |
| 150,000 | Great Northern Telegraph, of Copenhagen .. | 10 | 12½% | 15 % | 24 % | .. | 35 — 36 | 35 — 37 | 37 | 35⅞ | + ½ |
| 46,500 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | 4½% | 4½% | 4½% | 4½% | 100½—102½ | 100½—102½ | .. | .. | .. |
| 17,000 | Indo-European Telegraph .. .. .. | 25 | 10 % | 10 % | 13 % | 5 % | 57½— 59½ | 57½— 59½ | 58⅛ | 58 | .. |
| 251,127 | Marconi's Wireless Telegraph .. .. .. | 1 | .. | .. | .. | .. | 1 1/16— 1 3/16 | 1 1/16— 1 3/16 | .. | .. | .. |
| 72,680 | Monte Video Telephone Co., Ltd. Ord. .. | 1 | 3 % | 3 % | 4 % | .. | 15/16— 1 1/16 | 15/16— 1 | .. | .. | + 1/16 |
| 86,492 | Do. do. do. 5 % Pref. .. | 1 | 5 % | 5 % | 5 % | .. | 1— 1 | 1— 1 | .. | .. | .. |
| 1,993,333 | National Telephone, Pref. Stock .. .. | 100 | 6 % | 6 % | 6 % | 6 %§ | 111 —112 | 110½—111½ | 111½ | 101½ | — ½ |
| 1,966,667 | Do. do. Def. Stock .. .. .. | 100 | 4½% | 5 % | 5 % | 5 %§ | 108 — 110 | 108 —110 | 109 | 107½ | .. |
| 15,000 | Do. do. 6 % Cum. 1st Pref. .. .. | 10 | 6 % | 6 % | 6 % | 6 %§ | 13 — 15 | 13 — 15 | .. | .. | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. .. .. | 10 | 6 % | 6 % | 6 % | 6 %§ | 11 — 13 | 11 — 13 | .. | .. | .. |
| 250,000 | Do. do. 5 % Non-cum. 3rd P., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5 %§ | 5⅝— 5⅞ | 5⅝— 5⅞ | 5 1/16 | 5⅝ | .. |
| 2,000,000 | Do. do. 3½ % Deb. Stock Red. .. | Stock | 3½% | 3½% | 3½% | 3½% | 97½— 99½ | 98 —100 | 99 | 98½ | + ½ |
| 1,689,593 | Do. do. 4 % Deb. Stock Red. .. | 100 | 4 % | 4 % | 4 % | 4 % | 104 —106 | 104 —106 | .. | .. | .. |
| 179,313 | Oriental Telep. and Elec. 1 to 171,504, fully paid | 1 | 6 % | 6½% | 6½% | 6 % | 1½— 1⅝ | 1 1/32— 1⅛ | .. | .. | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. .. | 1 | 6 % | 6 % | 6 % | 6 % | 1 3/16— 1 1/16 | 1 3/16— 1 1/16 | .. | .. | .. |
| 100,000 | Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | 4 % | 4 % | 4 % | 4 % | 100 —103 | 100 —103 | .. | .. | .. |
| 11,839‖ | Reuter's .. .. .. .. .. .. .. | 8 | 5 % | 5 % | 5 % | 5 %§ | 7½— 8 | 7½— 8 | .. | .. | .. |
| 60,000 | Telephone Co. of Egypt, 4½ % Deb. Red. .. .. | 100 | .. | .. | .. | 4½% | 102 —105 | 102 —105 | .. | .. | .. |
| 3,287 | Submarine Cables Trust .. .. .. .. | Cert. | 6 % | 6 % | 6 % | 6 % | 125—128 | 125 —128 | 126 | .. | .. |
| 58,000 | United River Plate Telephone .. .. .. | 5 | 7 % | 8 % | 8 % | .. | 7 — 7½ | 7⅞ — 8 | .. | .. | + ⅛ |
| 40,000 | Do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | 5 % | 5 % | 5 % | 5 % | 5⅜— 5⅝ | 5⅜— 5⅝ | .. | .. | .. |
| 179,947 | Do. do. 5 % Debs. .. .. .. .. | Stock | 5 % | 5 % | 5 % | 5 % | 110 —112 | 111 —113 | 112 | .. | +1 |
| 15,600‖ | West African Telegraph, Shares .. .. | 10 | 2 % | 4 % | 4½% | 4 % | 10 — 10½ | 9⅞— 10½ xd | .. | .. | .. |
| 80,008 | W. Coast of America, 1 to 80,000 & 53,001 to 53,008 | 2½ | Nil | Nil | Nil | .. | 1/16— 1 1/16 | 1/16— 1 1/16 | .. | .. | .. |
| 150,000 | Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel. | 100 | 4 % | 4 % | 4 % | 4 % | 100 —102 | 100 —102 | .. | .. | .. |
| 207,930 | Western Telegraph, Ltd., Nos. 1 to 207,930 .. | 10 | 7 % | 7 % | 7 % | 5 % | 14 — 14½ | 14 — 14½ | 14⅜ | 14 | .. |
| 75,000 | Do. do. 5 % Debs. 2nd series, 1906 | 100 | 5 % | 5 % | 5 % | 5 % | 102 —104 | 102 —104 | 103½ | .. | .. |
| 568,380 | Do. do. 4 % Deb. Stock Red. .. | 100 | 4 % | 4 % | 4 % | 4 % | 103 —105 | 103 —105 | .. | .. | .. |
| 88,321 | West India and Panama Telegraph .. .. | 10 | Nil | Nil | Nil | .. | 1/16— 3/16 | 1/16— 3/16 | .. | .. | .. |
| 84,563 | Do. do. 6 % Cum. 1st Pref. .. .. | 10 | 7 % | 7 % | 6 % | 6 % | 8½— 9 | 8½— 8¾ | 8 7/16 | 8¼ | — ⅛ |
| 4,669 | Do. do. 6 % Cum. 2nd Pref. .. .. | 10 | Nil | Nil | Nil | .. | 6¾— 7¼ | 6¾— 7¼ | .. | .. | .. |
| 80,000‖ | Do. do. 5 % Debs., Nos. 1 to 1,800 .. | 100 | 5 % | 5 % | 5 % | 5 % | 101 —104 | 101 —104 | .. | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 850,000 | Anglo-Argentine Trams, 260,008 to 430,007 .. .. | 5 | .. | .. | 8 % | 6 %§ | 8¼— 8⅜ | 8⅛— 8¼ | 8 3/32 | 8⅛ | — ⅛ |
| 1,300,035 | Do. 5½ % Cum. Prefs., 1 to 260,007 .. | 5 | .. | 5 % | 5 % | 5½% | 5⅝— 6⅛ | 5⅝— 6⅛ | 6 | 5 1/16 | .. |
| 266,600 | Do. Permanent, 6 % Deb. Stock, 1888 | 100 | .. | 6 % | 6 % | 6 % | 142 —145 | 142 —145 | .. | .. | .. |
| 200,000 | Auckland E. Trams., 5 % 1st Mort. Deb. Stock .. | 100 | .. | 5 % | 5 % | 5 % | 105 —107 | 105 —107 | 107 | .. | .. |
| 530,000 | Babcock & Wilcox, 1 to 530,000 .. .. .. | 1 | .. | 17 % | 20 % | 16 %‖ | 3¾— 4 | 3¾— 4 | 3 3/32 | 3 1/16 | .. |
| 100,000 | Do. do. 6 % Cum. Pref., 1 to 100,000 .. | 1 | .. | 6 % | 6 % | 6 % | 1 1/16— 1 1/8 | 1 1/16— 1 1/8 | .. | .. | .. |
| 40,000 | British Aluminium 7 % Cum. Pref. .. .. .. | 5 | Nil | Nil | Nil | 3/6 | 5 — 5⅛ | 5 — 5⅛ xd | 5 1/16 | 5⅛ | .. |
| 20,000 | Do. do. "A" 6 % Cum. Pref. .. .. | 5 | Nil | Nil | Nil | 3/- | 4⅜— 5⅛ | 4⅜— 5⅛ xd | .. | .. | .. |
| 20,000 | Do. do. 4 % Funding Certs. .. .. | 5 | .. | .. | .. | .. | 2⅜— 3⅛ | 2⅜— 3⅛ | .. | .. | .. |
| 800,000‖ | Do. do. 5 % 1st Mort. Deb. Stock Red. | Stock | 5 % | 5 % | 5 % | 5 % | 98 —102 | 98 —102 | .. | .. | .. |
| 300,000 | British Columbia E. Rail Def. Ord. Stock .. .. | 100 | .. | 6 % | 6 % | .. | 124 —127 | 124 —127 | 125¼ | .. | .. |
| 300,000 | Do. 5 % Pref. Ord. Stock .. .. | 100 | .. | 5 % | 5 % | .. | 113 —116 | 111 —114 xd | .. | .. | .. |
| 115,000 | Do. 5 % Cum. Perp. Pref. Stock .. .. | 100 | .. | 5 % | 5 % | 5 % | 106 —109 | 106 —109 | .. | .. | .. |
| 240,400 | Do. 4½ % 1st Mort. Debs., 1 to 6,250 .. .. | 40 | .. | 4½% | 4½% | 4½% | 103 —105% | 103 —105 % | .. | .. | .. |
| 220,000 | Do. 4½ % Vancouver Power Debs., 1 to 2,200 | 100 | .. | 4½% | 4½% | 4½% | 102 —105 | 102 —105 | .. | .. | .. |
| 133,301 | British Electric Traction .. .. .. .. | 10 | 8 % | 6 % | 6 % | .. | 9¾— 10⅛ | 9¾— 10⅛ | 10 | 9⅞ | .. |
| 156,437 | Do. do. 6 % Cum. Pref. .. .. | 10 | 6 % | 6 % | 6 % | .. | 11 — 11⅛ | 11 — 11⅛ | 11⅛ | 11 | .. |
| 1,000,000‖ | Do. do. 5 % Perp. Deb. Stock .. | Stock | 5 % | 5 % | 5 % | 5 % | 121 —123 | 121 —123 | 122⅞ | 122⅛ | .. |
| 250,000 | Do. do. 4½ % 2nd Deb. Stock Red. | 100 | .. | .. | 4½% | 4½% | 98 —100 | 98 — 100 | 99⅜ | 99 | .. |
| 100,000 | British Insulated and Helsby Cables .. .. | 5 | 10 % | 8 % | 8 % | 8 %§ | 6¾— 7⅛ | 6¼— 7 | 6⅝ | .. | — ⅛ |
| 100,000 | Do. do. 6 % Cum. Pref. .. .. | 5 | 6 % | 6 % | 6 % | 6 %§ | 5¾— 6¼ | 5⅝— 6¼ | 6⅜ | .. | .. |
| 500,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | 4½% | 4½% | 4½% | 4½%§ | 103 —106 | 103 —106 | .. | .. | .. |
| 212,000 | British Thomson-Houston 4½ % 1st Mort. Debs. .. | 100 | .. | 4½% | 4½% | 4½% | 98 —100 | 98 —100 | .. | .. | .. |
| 2,000,000 | British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000 | 5 | .. | 6 % | Nil | .. | 2 — 2⅜ | 2⅛ — 2⅜ | .. | .. | + ⅛ |
| 1,016,353 | Do. do. 4 % Mort. Deb. Stock .. | 100 | .. | 4 % | 4 % | 4 % | 85 — 89 | 85 — 89 | .. | .. | .. |
| 50,000 | ¶Browett, Lindley & Co., Ord. .. .. .. | £1 | Nil | Nil | Nil | .. | 15/6 — 16/- | 15/6 — 16/- | .. | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. .. | £1 | Nil | Nil | Nil | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. | .. |
| 105,731 | Brush Electrical Engineering, Ord., 1 to 105,731 .. | 2 | Nil | Nil | Nil | .. | ¾— ⅞ | ¾— ⅞ | .. | .. | — ⅛ |
| 150,000 | Do. Non-cum. 6 % Pref. .. .. | 2 | 6 % | 6 % | 6 % | .. | 1¾— 2 | 1¾— 2 | .. | .. | .. |
| 125,000‖ | Do. 4½ % Perp. Deb. Stock .. | Stock | 4½% | 4½% | 4½% | 4½% | 93 — 97 | 94 — 98 | .. | .. | +1 |
| 125,000‖ | Do. 4½ % Perp. 2nd Deb. Stock | Stock | 4½% | 4½% | 4½% | 4½% | 78 — 81 | 80 — 83 | .. | .. | +2 |
| 500,000 | Buenos Ayres & Belgrano, 1 to 100,000 .. .. | 5 | .. | 3 % | 4 % | .. | 3½— 4 | 3⅝— 3⅞ | 3¾ | 3 7/16 | — ⅛ |
| 200,000 | Do. "A" 6 % Cum. Pref., 1 to 40,000 | 5 | .. | 6 % | 6 % | .. | 5 1/16— 5 3/16 | 5 1/16— 5 3/16 | .. | .. | .. |
| 137,500 | Do. "B" do. 1 to 27,500 .. .. | 5 | .. | 6 % | 6 % | .. | 5— 5⅛ | 5— 5⅛ | .. | .. | .. |
| 317,700 | Do. 5 % Deb. Stock .. .. .. | 100 | .. | 5 % | 5 % | 5 % | 107 —109 | 107 —109 | .. | .. | .. |
| 190,000 | Do. 5 % 2nd Deb. Stock .. .. | 100 | .. | 5 % | 5 % | 5 % | 102 —105 | 102 —105 | .. | .. | .. |
| 525,000 | Calcutta Trams., 1 to 105,000 .. .. .. | 5 | .. | 6 % | 8 % | 7 %§ | 9¼— 9⅜ | 9¼— 9⅜ | .. | .. | .. |
| 163,050 | Do. 105,001to 137,610 .. .. .. | 5 | .. | .. | .. | 3d. | 8¾— 9 | 8¾— 9 | .. | .. | .. |
| 350,000 | Do. 4½ % 1st Deb. Stock .. .. | 100 | .. | 4½% | 4 % | 4½% | 107 —109 | 107 —109 | .. | .. | .. |
| 35,000 | Callender's Cable Construction shares .. .. | 5 | 15 % | 12½% | 12½% | 10% | 11 — 12 | 11 — 12 | .. | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref. .. .. .. | 5 | 5 % | 5 % | 5 % | 5 % | 5⅜— 5⅝ | 5⅜— 5⅝ | .. | .. | .. |
| 300,000 | Do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | 4½% | 4½% | 4½% | 4½% | 109 —111 | 109 —111 | 110⅞ | .. | .. |
| 491,222 | Cape E. Trams., 1 to 491,222 .. .. .. | 1 | .. | 15 % | 10 % | 5 %§ | ⅞— 1⅛ | ⅞— 1⅛ | .. | .. | .. |
| 450,000 | Castner-Kellner Alkali, 1 to 450,000 .. .. | 1 | .. | 4 % | 4 % | .. | 1 — 1⅛ | 1 — 1⅛ | .. | .. | .. |
| 230,211 | Do. do. 4½ % 1st Mort. Deb. Stock | 100 | .. | 4½% | 4½% | 4½% | 97 —102 | 97 —102 | .. | .. | .. |
| 1,963,208 | Central London Railway, Ord. Stock .. .. | Stock | 4 % | 4 % | 4 % | 4 %§ | 93 — 95 | 93 — 95 | 94⅜ | 93½ | .. |
| 523,396 | Do. do. 4 % Pref. Stock .. | Stock | 4 % | 4 % | 4 % | 4 %§ | 101 —103 | 101 —103 | 102½ | 102 | .. |
| 523,396 | Do. do. Def. do. .. .. | Stock | 4 % | 4 % | 4 % | .. | 85 — 88 | 85 — 88 | 87½ | 86½ | .. |
| 1,330,000 | City and South London Railway .. .. .. | Stock | 3½% | 2⅜% | 2½% | 2 %§ | 46 — 48 | 45 — 48 | 48 | 47 | — ½ |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 .. .. .. | 3 | 5 % | 2½% | 2½% | .. | 1⅞— 2⅛ | 1⅞— 2⅛ | 2 | .. | .. |
| 100,000‖ | Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red. | .. | 5 % | 5 % | 5 % | 5 % | 94 — 99% | 94 — 99% | .. | .. | .. |

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

## SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

### ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

| Present Issue. | NAME. | Stock or Share. | Dividends for the last four years. 1902. | 1903. | 1904. | §1905. | Closing Quotations Nov. 29th. | Closing Quotations Dec. 6th. | Business done week ended Dec. 6th, 1905. Highest. | Lowest. | Rise + or Fall − |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260,000 | Dick, Kerr & Co., 1 to 52,000 | † 5 | .. | .. | 10 % | .. | 8½ — 9 | 8¾ — 9 | .. | .. | .. |
| 305,000 | Do. do. 6 % Cum. Pref., 1 to 61,000 | 5 | .. | 6 % | 6 % | 6 % | 6⅝ — 6¾ | 6⅝ — 6¾ | 6⅞ | .. | .. |
| 294,150 | Do. do. 4½ % Deb. Stock | 100 | .. | 4½% | 4½% | 4½% | 106 —108 | 106 —108 | .. | .. | .. |
| 600,000 | Dublin United Trams. (1896), 1 to 60,000 | 10 | .. | 5¼% | 6 % | 3 % | 13½ — 14½ | 13½ — 14½ | .. | .. | .. |
| 599,700 | Do. 6 % Pref. between 1 and 60,000 | 10 | .. | 6 % | 6 % | 6 % | 14½ — 15½ | 14½ — 15½ | .. | .. | .. |
| 63,400 | Do. 4 % Debs. | 100 | .. | 4 % | 4 % | 4 % | 99½ —100½ | 99½ —100½ | .. | .. | .. |
| 300,000 | Do. 3½ % "A" Debs. | 100 | .. | 3½% | 3½% | 3½% | 98 — 99 | 98 — 99 | .. | .. | .. |
| 300,000 | Do. 3½ % "B" Deb. Stock | 100 | .. | 3½% | 3½% | 3½% | 96 — 97 | 96 — 97 | .. | .. | .. |
| 99,261 | Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261 | 5 | Nil | Nil | 2½% | .. | 1⅝ — 1⅞ | 1⅝ — 1⅞ | 1⅞ | 1⅝ | .. |
| 17,139 | Do. "A" shares, 01—017,139 | 5 | Nil | Nil | 2½% | .. | 2 — 2¼ | 2 — 2¼ | 2¼ | .. | .. |
| 344,023‖ | Do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 4 % | 85 — 90 | 85 — 90 | .. | .. | .. |
| 100,000‖ | Do. 5 % 2nd Deb. Stock Prov. Certs. all pd. | 100 | 5 % | 5 % | 5 % | 5 % | 92 — 97 | 93 — 97 | .. | .. | .. |
| 112,100 | Electric Construction 1 to 112,100 | 2 | 6 % | 4 % | Nil | .. | ⅜ — ½ | ⅜ — ½ | .. | .. | .. |
| 31,390 | Do. do. 7 % Cum. Pref., 1 to 31,390 | 2 | 7 % | 7 % | 7 % | .. | 1⅝ — 2⅜ | 1⅝ — 2⅜ | .. | .. | .. |
| 200,000 | Do. do. 4 % Perp. 1st Mort. Deb. Stk. | Stock | 4 % | 4 % | 4 % | 4 % | 92 — 95 | 92 — 95 | .. | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 5 % | 5 % | 5 % | .. | 9¼ — 10 | 9¼ — 9⅝ | .. | .. | − ¼ |
| 200,000 | Do. do. 4 % Mort. Deb. | Stock | 4 % | 4 % | 4 % | 4 % | 96 —100 | 96 —100 | .. | .. | .. |
| 780,000 | Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000 | 10 | .. | 3 % | 4 % | 4 %§ | 5 — 5⅛ | 5 — 5⅛ | .. | .. | .. |
| 96,000 | Greenwood & Batley 7 % Cum. Pref. | 10 | .. | 7 % | 7 % | 7 % | 10⅝ — 11⅛ | 10⅝ — 11⅛ | .. | .. | .. |
| 80,000 | Do. do. 5 % Mort. Debs. | 100 | .. | 5 % | 5 % | 5 % | 102 —104 | 102 —104 | .. | .. | .. |
| 200,000 | Henley's (W. T.), Telegraph Works, Ord. | 5 | 20 % | 15 % | 15 % | 10%§ | 12⅜ — 13⅛ | 12⅜ — 13⅛ | 13 | .. | .. |
| 200,000 | Do. do. 4½ % Pref. | 5 | 4½% | 4½% | 4½% | 4½% | 5⅛ — 5⅜ | 5⅛ — 5⅜ | .. | .. | .. |
| 45,900 | Do. do. 4½ Mort. Deb. Stock | Stock | 4½% | 4½% | 4½% | 4½% | .. — .. | .. — .. | .. | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works. | 10 | 10 % | 10 % | 5 % | 2½%§ | 16 — 17 | 16 — 17 | 16⅛ | 16⅛ | .. |
| 800,000‖ | Do. do. 4% 1st Mort. Deb. | 100 | 4 % | 4 % | 4 % | 4 % | 99 —102 | 99 —102 | .. | .. | .. |
| 37,500 | †Liverpool Overhead Railway, Ord. | 10 | 1½% | 1¾% | 1½% | .. | 1⅞ — 2⅛ | 1⅞ — 2⅛ | .. | .. | .. |
| 10,000 | † Do. do. Pref. £10 paid | 10 | 5 % | 5 % | 5 % | 5 % | 6⅞ — 7⅛ | 6⅞ — 6⅞ | .. | .. | − ⅛ |
| 600,070 | London United Trams (1901), 1 to 50,007 | 10 | .. | 8 % | 6 % | 4 %§ | 10 — 11 | 10 — 11 | .. | .. | .. |
| 399,930 | Do. do. 60,008 to 100,000 (£4 paid) | 10 | .. | 8 % | 6 % | 4 %§ | 4 — 5 | 4 — 5 | .. | .. | .. |
| 1,125,000 | Do. do. 5 % Cum. Pref., 1 to 125,000 | 10 | .. | 5 % | 5 % | 5 % | 10 — 10⅛ | 10 — 10⅛ | 10⅛ | 10⅛ | .. |
| 1,331,000 | Do. do. 4 % 1st Mort. Deb. Stock | 100 | .. | 4 % | 4 % | 4 % | 100 —103 | 100 — 103 | 101½ | 101½ | .. |
| 314,016 | Metropolitan Electric Trams, Defd. | 1 | Nil | Nil | Nil | .. | 3/32 — 5/32 | 3/32 — 5/32 | .. | .. | .. |
| 500,000 | Do. 5 % Cum. Pref. | 1 | 5 % | 5 % | 5 % | 5 % | 1 — 1 1/16 | 1 — 1 1/16 | .. | .. | .. |
| 350,000 | Do. 4½ % Deb. Stock Red. | 100 | .. | .. | 4½% | 4½% | 106 —108 | 106—108 | 107 | .. | .. |
| 160,000 | Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000 | 5 | .. | .. | 6 % | 6 % | 4⅞ — 5⅛ | 4⅞ — 5⅛ | .. | .. | .. |
| 240,500 | Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500 | 10 | .. | 5 % | 5 % | .. | 8⅞ — 9¼ | 8⅞ — 9¼ | .. | .. | .. |
| 240,500 | Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500 | 10 | .. | 5 % | 5 % | 5 % | 9½ — 10 | 9½ — 10⅛ | .. | .. | + ⅛ |
| 245,000 | Do. 4½ % Deb. Stock | 100 | .. | 4½% | 4½% | 4½% | 101 —104 | 101 — 104 | .. | .. | .. |
| 37,350 | Telegraph Construction and Maintenance | 12 | 20 % | 20 % | 15 % | 10 % | 32 — 34 | 32 — 34 | 33½ | .. | .. |
| 150,000‖ | Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909 | 100 | 4 % | 4 % | 4 % | 4 % | 102 —104 | 102 —104 | .. | .. | .. |
| 3,599,200 | Undergd. E. R., Lon., 5 % Profit Shar. S. Nts. | .. | .. | .. | 5 % | 5 % | 99 —100 | 97 — 98 xd | 95 | 94 | .. |
| 540,000 | Waterloo & City Railway, Ord. Stock | 100 | 3½% | 3½% | 3½% | 3 %§ | 94 — 97 | 94 — 97 | .. | .. | .. |
| 333,330 | Willans & Robinson, 1 to 30,000 & 80,001 to 116,666 | 5 | 8½% | 6 %§ | .. | .. | 1⅛ — 2 | 1⅛ — 2 | .. | .. | .. |
| 333,330 | Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666 | 5 | .. | 6 % | .. | .. | 2⅛ — 3⅛ | 2⅛ — 3⅛ | 3⅛ | 3 | .. |
| 246,806 | Do. 4 % 1st Mort. Deb. Stock | 100 | .. | 4 % | 4 % | 4 % | 85 — 90 | 84 — 89 xd | .. | .. | .. |

### ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 70,000 | Bromley (Kent) E.L. & P., 1 to 14,000 | 5 | .. | 5 % | 5⅓% | 4 %§ | 5⅛ — 5⅜ | 5⅛ — 5⅜ | .. | .. | .. |
| 50,000 | Do. do. 4½ % 1st. deb. stock | 100 | .. | 4½% | 4½% | 4½% | 102 —105 | 102 —105 | .. | .. | .. |
| 29,377 | Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000 | 5 | 8 % | 10 % | 10 % | 9 % | 9¼ — 9⅜ | 9 — 10 | .. | .. | .. |
| 29 623 | Do. do. 7 % Cum. Pref. | 5 | 7 % | 7 % | 7 % | 7 % | 9 — 9¼ | 9 — 9¼ | .. | .. | .. |
| 10·782 | Central Electric Supply 4 % Guar. Deb. Stock | 100 | 4 % | 4 % | 4 % | 4 % | 104 —107 | 102 —105 xd | 103½ | .. | .. |
| 80·000 | Charing Cross and Strand Electricity Supply | 5 | 10 % | 8 % | 8 % | 5 %§ | 6 — 7 | 5⅝ — 6⅜ | 6⅛ | .. | − ⅛ |
| 80,000 | Do. do. do. 4½ % Cum. Pref. | 5 | 4½% | 4½% | 4½% | 4½% | 5⅛ — 5⅜ | 5⅛ — 5⅜ | .. | .. | .. |
| 40,000 | Do. "City Undertaking" 4½ % Cum. Prf. | 5 | 4½% | 4½% | 4½% | 4½% | 4⅜ — 5 | 4⅜ — 5 | .. | .. | .. |
| 40,000 | Do. do. 1903 | 5 | .. | 4½% | 4½% | 4½% | 4⅜ — 5 | 4⅜ — 5 | .. | .. | .. |
| 350,000 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 4 % | 103 —105 | 103 —105 | .. | .. | .. |
| 44,436 | Chelsea Electricity Supply, Ord. | 5 | 5½% | 5½% | 6 % | 4½%§ | 5⅜ — 6¼ | 5 — 6 | 5⅛ | .. | − ⅛ |
| 150,000‖ | Do. do. 4½ % Deb. Stock Red. | Stock | 4½% | 4½% | 4½% | 4½%§ | 110 —112 | 110 —112 | .. | .. | .. |
| 70,595 | City of London Elec. Lighting, Ord. 40,001—110,595 | 10 | 5 % | 5 % | 6 % | 5 % | 11⅜ — 12½ | 11⅛ — 12½ | 11⅞ | 11⅛ | .. |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 | 10 | 6 % | 6 % | 6 % | 6 % | 13½ — 14½ | 13½ — 14½ | 13⅝ | 13⅜ | .. |
| 400,000‖ | Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd. | .. | 5 % | 5 % | 5 % | 5 % | 124 —128 | 124 —128 | .. | .. | .. |
| 300,000 | Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd. | 100 | 4½% | 4½% | 4½% | 4½% | 104 —106 | 103 —106 | 104 | .. | − ⅛ |
| 40,000 | County of Durham Electrical Power, Ord. | 2 | .. | .. | .. | .. | 2⅛ — 2⅜ | 2 1/16 — 2 1/16 | .. | .. | — 1/16 |
| 50,000 | Do. do. do. 5 % Pref. | 5 | .. | .. | .. | .. | 5⅛ — 5⅜ | 5⅛ — 5⅜ | .. | .. | .. |
| 40,000 | County of London Electric Lighting, Ord. 1—40,000 | 10 | 4 % | 4 % | 4½% | 4 %§ | 9¼ — 9⅝ | 8⅞ — 9⅜ | 9⅛ | .. | − ⅛ |
| 80,000 | Do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | 6 % | 6 % | 12⅜ — 12⅝ | 12⅜ — 12⅝ | 12⅜ | .. | .. |
| 400,000‖ | Do. do. 4½ % Deb. Stock | .. | 4½% | 4½% | 4½% | 4½% | 112 —115 | 112 —115 | .. | .. | .. |
| 250,000 | Do. do. 4½ % 2nd Deb. Stock | Stock | 4½% | 4½% | 4½% | 4½% | 102 —104 | 102 —104 | .. | .. | .. |
| 70,000 | Edmundson's Electric Corporation, Ord. Shares | 5 | 7 % | 7 % | 7 % | .. | 5⅛ — 5⅜ | 5⅛ — 5⅜ | 5 1/16 | 5⅛ | .. |
| 80,000 | Do. do. 6 % Cum. Pref. | .. | 6 % | 6 % | 6 % | 6 % | 5⅝ — 6⅛ | 5⅝ — 6⅛ | .. | .. | .. |
| 300,000‖ | Do. do. 4½ % 1st Mort Deb. Stk | 100 | 4½% | 4½% | 4½% | 4½% | 108 —110 | 108 —110 | 107⅞ | .. | .. |
| 50,000 | Folkestone, 1 to 10,000 | 5 | .. | 5½% | 5½% | 4 %§ | 5⅛ — 5⅜ | 5⅛ — 5⅜ | .. | .. | .. |
| 50,000 | Do. 5 % Cum. Pref., 1 to 10,000 | 5 | .. | .. | .. | 5 % | 5 — 5⅛ | 5 — 5⅛ | .. | .. | .. |
| 50,000 | Do. 4½ % 1st. Deb. Stock | 100 | .. | 4½% | 4½% | 4½% | 101 —104 | 101 —104 | .. | .. | .. |
| 65,000 | Hove, 1 to 13,000 | 5 | .. | 8½% | 8½% | 8 % | 8 — 8¼ | 8⅛ — 8¼ | .. | .. | + ⅛ |
| 10,000 | Do. New (£5 10s. paid) | £3 | .. | 8½% | 8½% | 8 % | 5⅛ — 6 | 5⅝ — 6⅛ | .. | .. | + ⅛ |
| 37,300 | Do. 4 % Deb. Stock | 100 | .. | 4 % | 4 % | 4 % | 94 — 97 | 94 — 97 | .. | .. | .. |
| 7,300 | Do. 4½ % Deb. Stock | 100 | .. | 4½% | 4½% | 4½% | 96 — 99 | 98 —100 | .. | .. | +1½ |
| 21,000 | Kensington and Knightsbridge Electric Ord. | 5 | 10 % | 12½ | 12 % | 10 % | 10⅜ — 11⅛ | 10⅜ — 11⅜ | 11⅛ | .. | .. |
| 136,000 | Do. do. do. 4 % Deben. Stk. | Stock | 4 % | 4 % | 4 % | 4 % | 98 —101 | 96 —101 | .. | .. | −1 |
| 111,000 | London Electric Supply Corporation, Limited, Ord. | 3 | Nil | Nil | 3 % | .. | 1⅜ — 2⅛ | 1⅜ — 2⅛ | 2 1/16 | .. | .. |
| 60,000 | Do. do. do. 6 % Pref. | 5 | 6 % | 6 % | 6 % | 6 % | 4⅜ — 5⅛ | 4⅜ — 5⅛ | 5⅛ | .. | .. |
| 371,895 | Do. do. 4 % 1st Mort. Deb. Stk. Red. | Stock | 4 % | 4 % | 4 % | 4 % | 99 —102 | 99 —102 | 101¼ | 100¼ | .. |
| 100,000 | Metropolitan Electric Supply, 1 to 100,000 | 5 | 7½% | 8½% | 10 % | 10 %§ | 9⅛ — 10⅛ | 9⅛ — 10⅛ | 10 3/16 | 9 7/16 | — 1/16 |
| 76,121 | Do. do. 4½ % Cum. Pref. 1—71,106, £3 pd. | 5 | 4½% | 4½% | 4½% | 4½% | 5⅜ — 5⅞ | 5⅜ — 5⅝ | 5⅝ | .. | — 1/16 |
| 220,000‖ | Do. do. 4½ % 1st Mort. Deben. Stock | .. | 4½% | 4½% | 4½% | 4½% | 109 —113 | 109 —113 | .. | .. | .. |
| 250,000‖ | Do. do. 3½ % Mort. Deben. Stock Redem. | Stock | 3½% | 3½% | 3½% | 3½% | 97 — 99 | 97 — 99 | 98½ | 98½ | .. |
| 250,000 | Midland Electric Corporation, 4½ % 1st Mort. Deb. | 100 | 4½% | 4½% | 4½% | 4½% | 101 —103% | 101 —103 % | .. | .. | .. |
| 285,045 | Newcastle-on-Tyne, 1 to 57,009 | 5 | .. | 8 % | 8 % | 2½%§ | 8 — 8¼ | 8 — 8¼ | .. | .. | .. |
| 89,955 | Do. 57,010 to 75,000 | 5 | .. | .. | .. | 2½% | 8 — 8¼ | 8 — 8¼ | .. | .. | .. |
| 285,045 | Do. 5 % Pref., 1 to 57,009 | 5 | .. | 5% | 5 | 5 % | 6⅛ — 6⅜ | 6⅛ — 6⅜ | .. | .. | .. |
| 89,955 | Do. 57,010 to 75,000 | 5 | .. | .. | .. | 2½% | 6⅛ — 6⅜ | 6⅛ — 6⅜ | .. | .. | .. |
| 10,852 | Notting Hill Electric Lighting | 10 | 6 % | 6 % | 7 % | 6 % | 14½ — 15½ | 14½ — 15½ | .. | .. | .. |
| 59,000 | Do. do. 4 % 1st Mort. Deb. | 100 | 4 % | 4 % | 4 % | 4 % | 98 —100 | 98 —100 | .. | .. | .. |
| 92,500 | Oxford, 1 to 96 and 407 to 18,810 | 5 | .. | 6½% | 7 % | 5 %§ | 6⅜ — 6⅞ | 6⅜ — 6⅞ | .. | .. | .. |
| 50,000 | Do. 4 % Deb. Stock | 100 | .. | 4 % | 4 % | 4 % | 100 —102 | 100 —102 | .. | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. | 5 | 14½% | 14½% | 14½% | 10%§ | 13 — 14 | 13 — 14 | .. | .. | .. |
| 20,000 | Do. do. 7 % Pref. 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 7 %§ | 8 — 9 | 8 — 9 | 8½ | .. | .. |
| 150,000‖ | Do. do. 3½ % Deb. Stock Red. | 100 | 3½% | 3½% | 3½% | 3½% | 98 —100 | 98 —100 | .. | .. | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. | 5 | 2½% | 4 % | 4 % | .. | 2 — 2¼ | 2 — 2¼ | .. | .. | .. |
| 50,000 | Do. do. do. 4 % Deb. Stock | Stock | 4 % | 4 % | 4 % | 4 % | 76 — 80 | 76 — 80 | .. | .. | .. |
| 65,000 | South London Electricity Supply, Ord. | 5 | 13% | 3 % | 4 % | .. | 3⅛ — 3⅜ | 3⅛ — 3⅜ | 3¼ | .. | .. |
| 100,000 | South Met. Elec. Lt. & Power (Ord. | 1 | Nil | Nil | Nil | .. | 1/32 — 3/32 | 1/32 — 1/32 | .. | .. | .. |
| 50,000 | *(Late Blackheath and Greenwich* 7 % Pref. | 1 | Nil | 7 % | 7 % | 7 % | 1 7/16 — 1 7/8 | 1 7/16 — 1 7/8 | .. | .. | .. |
| 100,000 | *Dist. E.L.Co.)* 4½ % 1st Deb. Stk. | 100 | 4½% | 4½% | 4½% | 4½% | 105 —108 | 105 —108 | .. | .. | .. |
| 30,000 | Urban Electric Supply, Ord. | 5 | 5 % | 5 % | 5 % | 5 % | 4¼ — 4⅜ | 4¼ — 4⅜ | .. | .. | .. |
| 30,000 | Do. do. 5 % Cum. Pref. | 5 | 5 % | 5 % | 5 % | 5 % | 5 — 5⅛ | 5 — 5⅛ | 5⅛ | .. | .. |
| 200,000 | Do. do. 4½ % 1st Mort. Db. Stk. Red | 100 | .. | .. | 4½% | 4½% | 104 —106 | 104 —106 | 106⅜ | 105 | .. |
| 110,000 | Westminster Electric Supply, Ord. | 5 | 12 % | 13½% | 14 % | 13 %§ | 11⅜ —12¾ x rts | 11¼ — 12¼ x rts | 12⅜ | 11⅛ | .. |
| 28,151 | Do do. 5 % Cum. Pref. | 5 | 5 % | 5 % | 5 % | 5 % | 6 — 6½ x rts | 5⅞ — 6¼ | 6¼ | 5⅞ | — ⅛ |

Shares not officially quoted:—Mackay Companies, ord., 53½—54½. Pref. 73½—74½.

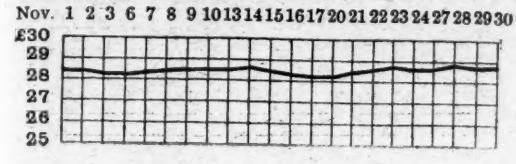
† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 4 per cent. (September 28th, 1905).

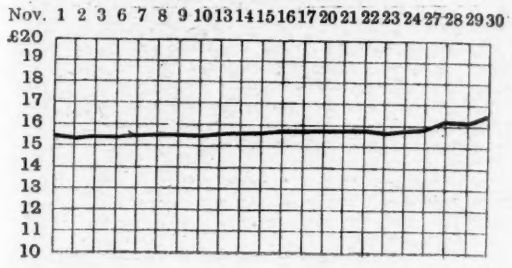
## METAL MARKET.

**Fluctuations in November.**

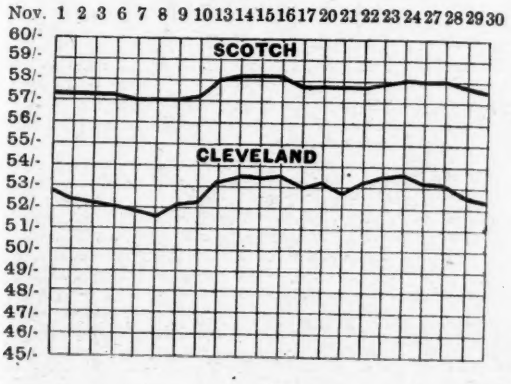
### SPELTER (G.O.B's.)



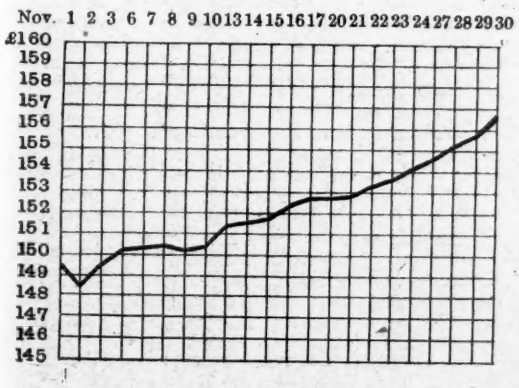

### LEAD (ENGLISH)



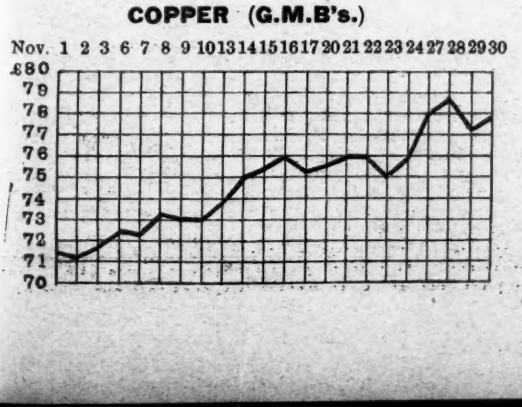

### IRON.




### TIN.




### COPPER (G.M.B's.)




## USES OF ELECTRICITY IN MINES.

(*Concluded from page* 912.)

Underground haulage is next dealt with, and two interesting curves are given, which we reproduce. Fig. 5 shows a load curve taken from a 25-h.p. single rope-haulage motor, and shows clearly the excessive variations of load owing to curves and steep places on

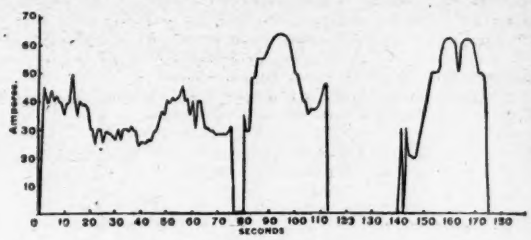



Fig. 5.

the incline. This demand on the mains was repeated every half-hour. Fig. 6 shows, on the other hand, a load curve taken from a 25-h.p. single-rope continuous haulage plant which is remarkably steady.

The effect on the generating station of the variable loads on different classes of mining motors is shown in the diagram fig. 7, which gives readings taken for three minutes from a dynamo supplying three haulage engines from 7½ to 25 h.p. As will be seen, at times there is no demand whatever, hence it is important for

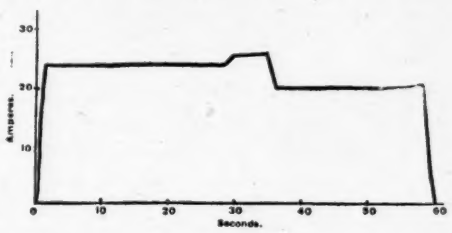



Fig. 6.

effective governors to be used on the engine. Mr. Ravenshaw cites a case where the governors failed on a large proportion of the load being thrown off, the pressure rose from 500 to 1,200 volts, and a great deal of damage was done. "Reliability, good running, and a minimum cost in repairs and attendance are always required in a mine, but extreme economy in steam consumption is not attempted."

Electric lighting, shot firing, signalling, alternating and direc currents are then discussed, and from the latter we quote the following: "Both direct and alternating currents have been used in mines with success, but experience points to the fact that th alternating system is the more suitable. Where large powers are required the difficulty in breaking heavy direct currents in enclosed

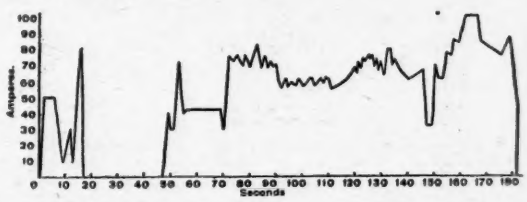



Fig. 7.

boxes is very great; oil switches cannot safely be employed owing to the quick break causing a heavy rise of potential in the circuit, and the same objections apply to magnetic blow-outs. With alternating currents oil switches can be safely used, and this one point alone is sufficient to give that system a great advantage."

Mr. Ravenshaw then deals with precautions, and says, "It is of absolute importance that the safety of the mine is ensured, and a very long step towards immunity from accident is to put down a first-rate plant in the first place. In a colliery where capital expenditure is of necessity kept low, there is a temptation to buy in the cheapest market. Electrical machinery, however, has been reduced in price to a remarkable extent, and there is no possible excuse for those responsible risking the lives of men in their charge by purchasing in the very lowest market. *I speak strongly on this question, as I have seen a great deal of dangerous rubbish in use,* and I am glad to say that the report of the Home Office Committee made a very strong point on this question." The italics are ours, and we cannot but endorse the views of the speaker.

As to costs the following is given:—"Where steam engines are used, an excellent electric generating plant suitable for a works or colliery can be put down for £22 per kilowatt output. A gas

engine plant using coke or anthracite would cost £24 per kilowatt, and if coke oven gas is used £22 per kilowatt. An exhaust steam plant of the Rateau type would probably cost from £18 to £20 per KW. These figures are taken from actual practice, and make no allowance for spare plant.

"With regard to coal consumption, it must be remembered that, although coal may be cheap, boilers cost money to put down and maintain. . . . On an average, for every ton of coal burnt, the costs for labour, boiler repairs, depreciation and interest on capital amount to at least 2s. 6d.; consequently, even if the coal cost nothing, a ton saved per day would mean a saving of at least £40 per annum. In large collieries from 50 to 80 tons a day are burnt under the boilers, and in many cases it is pr. ctically certain that this consumption could be reduced by one-half."

The following consumptions, if obtained all the year round, are not likely to be improved on with a 200-KW. plant working 16 hours a day:—Steam engines, 5 lb. per KW.-hour; gas engines with anthracite, 1·85 lb. per KW.-hour; gas engine with coke, 2·25 lb. per KW.-hour. The costs with a good load factor should not exceed:—

| | | |
|---|---|---|
| Coal and boiler or producer charges ... | 0·20d. | per unit. |
| Labour, stores, repairs ... ... ... | 0·15d. | ,, |
| Depreciation and interest ... ... | 0·25d. | ,, |
| | 0·60d. | ,, |

This, however, may be considered high, but everything depends upon the load factor. We know of one colliery where the total cost, with an 11-hours full load factor for 280 days per year, would be under 0·4d. per unit, and Mr. Ravenshaw himself says:—"I am convinced that a colliery of fair size can generate electricity for its own use at a considerably lower rate than a public supply can afford to sell it at a profit, if a proper allowance is made for depreciation in both cases," a statement which is well worth the careful consideration of colliery owners and others who are about to adopt electric driving to any extent.

## PROCEEDINGS OF INSTITUTIONS.

### INSTITUTION OF ELECTRICAL ENGINEERS.

*Abstract of Inaugural Address delivered in London on November 9th by* JOHN GAVEY, C.B., *President.*

(*Concluded from page* 906.)

**Wireless Telegraphy.**

Wireless telegraphy, so called, has attracted a great deal of intermittent attention for many years past.

It may be of advantage to briefly review the gradual development of the art from the date of Marconi's early work. It will, no doubt, be remembered that after a period of experiments, first in Italy, then in this country, a crucial trial was made in the year 1896, under the auspices of the Post Office, across the Bristol Channel from Lavernock Point, first to the Island of Flatholm, and then to Breamdown, near Weston-super-Mare. At that period, what has by some been termed the "Whip Crack Method" only had been tried; that is to say, a powerful spark coil was connected, one terminal to the vertical conductor, the other to the earth. This arrangement emits a very powerful impulse which is damped down almost immediately, and it is probably the first single impulse alone which affects the receiver at a distance. Elementary attempts at tuning were made by various experimenters during this period, but the art was not sufficiently developed to admit of any really useful results being obtained. The coherers were probably far too sensitive, and the difficulty experienced in the early days was rather due to their not decohering than to their failing to respond to the electrical waves. In course of time this difficulty was remedied by the use of an oscillating transformer in the receiving circuit which admitted of the use of less sensitive coherers, and excellent results were obtained, but owing to the fact that every receiver within a certain definite range of a given transmitting apparatus responded to each impulse, and all receivers were affected by all transmitters within range, it appeared at first as though Marconi's attempt to increase the effective limit of his apparatus would tend to restrict rather than to extend the use of the system. He and others interested in wireless telegraphy, therefore, turned their attention to the establishment of syntony between the transmitting and the receiving apparatus, and a marked degree of success has attended their efforts. This syntony is usually effected by connecting one or more closed oscillating circuits to the source of energy and coupling these either direct or through an oscillating transformer with the vertical antennæ, the closed oscillating circuit and the vertical antenna being in unison, *i.e.*, having the same frequency. A closed oscillating circuit includes a capacity and an inductance, and therefore for each primary impulse a train of waves is generated. The first portion of the wave has not such an amplitude as when the Whip Crack Method is used, but this is more than counterbalanced by the effect of the long train of oscillations, which results in restricting to a great extent the visible effect to receivers tuned in harmony, other receivers not so tuned not responding when a certain critical distance is passed. In the next place, by a judicious combination of oscillating circuits with antennæ of suitable capacity, the amount of energy that can be utilised for the transmission of signals may be increased from the small limits imposed when an ordinary induction coil is used to practically any given amount—an utter impossibility with the original method of working. Of course, where a very powerful exciting system is in use, the radiating surface must be increased proportionately, and the well-known method of multiple antennæ has been designed to achieve this end. At the receiving station, the tuning is effected by the addition either of inductance or of capacity, the receiving installation being brought into as perfect syntony with the transmitter as is possible. In addition to this, special devices have been introduced in the receiving circuit for the elimination of waves of other periodicities so that even Whip Crack transmission can to a great extent be eliminated. The effect of having the transmitting and the receiving apparatus in harmony was shown in an admirable manner by the Post Office experiments, recently carried out and described by Messrs. Duddell and Taylor, which gave graphical measurements of the energy received under both conditions.

A great deal has been said by rival inventors as to the possibilities of wireless telegraphy, and some exaggerated claims have been made on their behalf which have led to counter statements by some interested in other methods of communication. Whilst on the one hand it may be fairly assumed that wireless telegraphy is not, under any circumstances, likely to supplant or even to compete seriously with inland methods of intercommunication, there is no doubt that there is a very distinct and important sphere of utility awaiting its further development. For intercommunication between ship and shore, and ship and ship, much has been done, although much remains to be done. For intercommunication between neighbouring coasts there is also a possible future, but this depends almost wholly on the further development of the methods of syntony or tuning. It does not appear to be very probable that it will seriously compete with the highly developed cable communication in the near future, although it may in many instances supplement that service.

**Construction.**

No marked changes have taken place in the methods of overhead construction, but in underground telegraphs something approaching a revolution is in progress. The introduction of the modern multiple cable insulated by dry paper and enclosed in lead sheath has gone a long way in the direction of overcoming the financial difficulty of cost and the electrical difficulty of high static capacity.

In cables of this type relatively large conductors weighing from 100 to 200 lb. per mile can be provided with a static capacity of 0·1 microfarad per mile, and where a large number of wires have to be provided, at a total expenditure not very unduly in excess of that necessary for overhead wires.

As soon as this type of cable became available for use, the Post Office took the initial step in the construction of a line containing 76 wires, enclosed in a 3-in. iron pipe from London to Birmingham, a distance of 117 miles. This line was commenced in 1897, and was completed in 1899. The general result was admirable from every point of view, and the steadiness of working and the freedom from interference by atmospheric or other causes was so great that the Postmaster-General subsequently decided to extend the London-Birmingham line to Glasgow. In the interval many types of paper-insulated cables had been devised with a view to obtain a form suitable for use with earthed circuits, and therefore to a great extent free from mutual induction, either static or electro-magnetic, the ultimate outcome of which was the design of a conductor insulated with paper, each insulated conductor being lapped with copper foil, and the whole of the wires cabled and sheathed with lead.

It was finally determined to continue the London-Birmingham section northwards by the laying of a cable containing 37 pairs of the ordinary paper-insulated wires as a core surrounded by 29 copper-screened single-wire conductors; this decision was arrived at after it had been proved conclusively that where quadruplex or high-speed circuits were required, it was possible to obtain satisfactory working with the quadruplex or Wheatstone on a metallic loop, and to superimpose thereon a key duplex. Where quadruplex is therefore in use on a long circuit, six channels are obtained on two wires, or a Wheatstone duplex and a key duplex can be worked on each loop. Again, it has been proved that between London and Glasgow, by the use of a repeater at Preston or Warrington, a speed of 200 words per minute can be obtained on these wires with Wheatstone apparatus, so that it will be observed that a great step has been made by the substitution of a moderately economical system of underground work susceptible of working at high rates of speed, for the old costly and slow methods which the use of gutta-percha involved where land telegraphy was concerned.

The main underground line from London to Glasgow will be completed by March or April, 1906, and other important sections of main line, notably a section from London to Chatham, are in hand.

Here, perhaps, I may fitly state that the Post Office and the general public owe a debt of gratitude to our British manufacturers of electrical plant for the energetic and able manner in which they meet all requirements, however onerous, made upon them. They spare neither time, trouble, nor expense in an endeavour to meet the most difficult specifications, and it is not too much to say that without their assistance this record of modern progress could not have been realised.

**Telephones.**

Not the least remarkable of the modern developments of electrical engineering is the extraordinary growth of the telephone service throughout the whole of the world.

As the result of successive inventions, a steady and rapid improvement in the outdoor plant available for exchange work has taken place, and so far as modern telephone switch is concerned,

these improvements have been wholly in the direction of reducing the amount of talk on the part of the operator, that was necessary under the old conditions. This has been brought about by the provision of a complete system of automatic signalling whereby she is kept abreast of her work, so that, with the exception of asking for the number of the subscriber who is wanted, there should, in all ordinary cases, be no need for conversation between the subscriber and the operator, this being accompanied by a corresponding increase in the speed of working. In fact, one system goes so far as to render it unnecessary even to ask for the number of the subscriber required, that information being printed by the caller on a Morse slip. This tendency to reduce the operator to a species of intelligent automaton naturally suggests the possibility of the entire elimination of the operator, and the introduction of suitable automatic apparatus at the exchange. Several very ingenious methods of attaining this end have been devised, and one system has achieved a certain measure of success in America, several exchanges of some magnitude having been equipped with apparatus of this type. The subject is being carefully studied at the present time in America, and there appears to be some possibility of development in the not distant future that may lead to important modifications in present methods.

There appears to be an occasional tendency to look upon telegraphs and telephones as a little apart from serious engineering undertakings, but when modern telephone practice is considered, it will be found that, in the complexity of the system, the amount of electrical energy used for the purpose of signalling, and the extent of the works undertaken, a telephone system regarded from the engineering standpoint is in no degree behind any other electrical enterprise. As an illustration, it may be stated that, in carrying out the preliminary arrangements for serving about one-third of the metropolitan area, the Post Office has already excavated 565¼ miles of trench, it has laid 1,251 miles of duct, it has provided 162,210 miles of wire, and the weight of copper buried in the London streets amounts to 2,200 tons; and this apart from the work carried out by the National Telephone Co. in the same districts.

The secondary cells used for signalling and common battery speaking at the Central Exchange have a capacity of 5,500 ampere-hours, and the number of glow lamps in use on the existing Central Exchange for signalling purposes is 25,000. It may be added, however, in illustration of the growth of the system, that the first contracts for the Post Office system in London were entered into on February 24th, 1900, and the first Exchange was opened on February 24th, 1902, with 169 subscribers, the ultimate capacity being 14,000 subscribers. Its growth was so rapid that within two years of its being opened it became necessary to commence the installation of a second exchange which is being constructed within the same building and which will shortly be opened with a further capacity of 20,000 subscribers, a corresponding enlargement of the general appliances in the building being involved.

The growth in the number of telephones provided by the American Telegraph and Telephone Companies (commonly known as the Bell Companies) in the United States of America, is absolutely startling. I visited America in 1898, at which date the company had about 400,000 stations open. I have just returned from another visit, and find that they have 1,950,000 stations at work, an increase of 1,450,000 in seven years, and they are still progressing at the same pace. Domestic and other reasons appear to foster the use of the telephone.

The most important adjunct to the local exchange system is the trunk line, or long-distance service, as it is variously called. In 1896 the Post Office acquired, by purchase, such of the trunk lines as had been erected by the National Telephone Co., and not only did it at once erect such additional wires as were necessary to provide a comprehensive service covering the whole country, but it has been engaged year by year in erecting additional trunks. Such is the favour with which the trunk service generally is regarded, that it is difficult to keep pace with the demand for additional wires.

In the year ending March 31st, 1896, there were 165 circuits, and 17,500 miles of wire in use; at March 31st, 1905, there were 1,604 circuits, and 112,744 miles of wire actually in use.

The determination of the distance over which telephonic speech is possible on various types of telephone circuit is a question of the greatest theoretical and practical interest, and it is one that has received much careful consideration. The simple K.R. law applies with some degree of accuracy to telephonic cables in cases in which wires of approximately the same gauge are concerned, but it fails in cases in which the electrical constants R K and L vary materially, and it is quite inapplicable as part of a general law to open lines where self-induction is a marked factor or where the conductivity of the wires varies materially.

On comparing a large number of results obtained over Post Office lines of different character, the following rough empirical formulæ were found to give fairly concordant results within certain limits.

Aerial lines of 100 lb. copper and upwards:—

$$M = 210\sqrt{\frac{l}{KR^{1\cdot75}}}.$$

For unloaded paper cables—

$$M = 85\sqrt{\frac{l}{KR}}$$

where M = limits in miles.

The ordinary electrical conditions in a circuit which may modify or effect an impulse *in transitu* are the following:—

A, resistance.
B, electrostatic capacity.
C, self-induction.
D, insulation.
E, abrupt and numerous alterations in the circuit which may cause reflection.
F, interference from extraneous cause, *i.e.*, static or magnetic induction, leakage, &c., from neighbouring circuits.

When an electrical impulse is started in a conductor, if the latter had neither resistance, capacity, nor self-induction, and if the insulation were perfect, the wave would move on without attenuation or distortion. The effect of resistance or of uniformly distributed low insulation, however, results in a definite attenuation which increases with the length of the circuit, and, further, the effect of capacity is to cause the wave to spread out, both forwards and backwards, this "tailing," as it is termed, not only increasing the attenuation by lowering the amplitude, but causing distortion of the wave itself and also of the neighbouring impulses, with which it interferes. This distortion eliminates the higher notes and harmonics, and in extreme cases causes the voice to lose its characteristic tone, and ultimately to become inarticulate.

The actual practical work attenuation, due partly to resistance, and partly to electrostatic capacity, is the dominant factor, and this attenuation, when combined with disturbance from neighbouring electrical conductors, actually determines the limits of speech. This view is supported by a comparison of the results obtained by calculation and those obtained by actual experiment. The remaining factors, although they must have some influence on the results, can in practice and under conditions which obtain in a simple metallic circuit be neglected.

As a preliminary to the determination of the limits of speech, it is necessary to ascertain the degree of volume and articulation, or, in other words, the audibility, which may be accepted as satisfactory, and further to establish standard circuits with well-known constants of R L and K, to which all lines may be reduced either by calculation, by experiment, or preferably by both. For this purpose, both in America and England, one of the types of ordinary lead-covered paper-insulated cables, in which the above constants are measurable, has been selected, and the dimensions of the English standard cable, which agree closely with American figures, are as follows:—

| | Gauge S.W.G. | Weight per mile. | Diameter Mils. | R (loop). Ohms. | K wire to wire. Microfarad. | L. | Insulation. |
|---|---|---|---|---|---|---|---|
| English ... | 20 | 20 lb. | 36 | 88 | 0·056 | 0·001 | 200 |

It is generally considered that from 42 to 46 miles of the above-named standard cable is the effective commercial limit, although conversations have been held by experts over 60 miles of such a cable.

This being accepted, two methods can be adopted for determining the limits of speed on various types of telephone circuits.

In the first place, the attenuation is calculated for various types of cable, tables of ratios which express the relative equivalence of each type of circuit to the standard cable are prepared, and the limit of commercial speech having been fixed in miles of standard cable, the limit on all other types of conductors is a simple matter of calculation.

The second method, of course, consists in a direct comparison of all existing types of line with a standard cable. A lengthy series of experiments has been made on all classes of Post Office conductors, overhead, underground, and submarine, and they have been balanced by means of a standard apparatus to their equivalent lengths of actual standard paper cable.

The calculated limits of speech based on attenuation agree absolutely with experimental results on all the underground cables. There are, however, variations in the calculated and observed results obtained on overhead lines, and these are no doubt due to variations in insulation and to slight disturbances which affect the audibility materially when approaching the limits.

Another method of investigating the problem of telephonic transmission has been undertaken at the Post Office. Two circuits have been selected, one consisting of a mile of the standard cable already referred to, and the second consisting of 20 miles of similar cable. A Duddell oscillograph has been used for observing simultaneously the curves due to the action of the induction coil at the transmitting end and the corresponding curves at the receiving end of the circuits. A number of letters, both vowels and consonants, have been rapidly spoken into the transmitter, and the respective transmitted and received curves for each have been recorded in the usual photographic manner.

On the one-mile length the curves at opposite ends are almost counterparts one of the other, the difference of amplitude being inappreciable, and all the irregularities of each transmitted curve being faithfully reproduced at the distant end. Where, however, the longer length of cable is introduced the difference of amplitude is most marked, and although it is, perhaps, somewhat more difficult to compare the shapes of the two curves, they still bear a substantial resemblance one to the other.

It is, of course, obvious that any marked improvement in the normal types of telephone apparatus will tend to extend the ranges given in the tables. Further, it will be observed that these ranges are based on a 43-mile limit of standard cable, although under favourable conditions, and with expert users of the telephone, much longer distances are practicable. These limits also presuppose that the telephone is joined directly on to the line, and they have to be cut down when the exchange apparatus and the subscriber's line are added by an amount equal to their equivalent mileage.

I have already referred to the question of increasing the self-induction of telephone lines by the addition of induction coils at definite lengths. In America the question has been dealt with by Dr. Pupin, and considerable work has been done in that country in the direction of loading underground cables, as it is termed. The Post Office took up the subject at an early date in connection with its main underground lines, and a marked measure of success has already been obtained. In one case, that may be taken as an illustration, a cable containing 56 100-lb. conductors was loaded by

the insertion of coils at intervals of a mile; the original factors were R = 17 ohms, K = 0·053 microfarad, L. = 1·4 millihenries, and the total added inductance per mile amounted to 40 millihenries, the original n being raised to 21·34 ohms per mile by the addition of the coils. The equivalent range of speech was, however, increased from 66 to 176 miles. In the Post Office experiments on its long-distance lines so far, the use of iron in any portion of the coils has been found to be deleterious as compared with coils without iron cores. True, the volume of sound was always materially raised where iron was used, but at the cost of articulation, whilst a judicious addition of self-induction without iron always improved both the volume and the articulation.

Very satisfactory results have, however, been obtained in America and in Germany by the use of ring-coils with extremely fine iron cores, and further progress in this direction may be anticipated.

Experiments with overhead conductors have not proved so satisfactory as with underground cables. The variation in the insulation of the open wires upsets the balancing due to the coils, and lightning troubles have affected the coils.

**Unsolved Problems.**

These are neither few nor unimportant. The telegraphic problem is by no means finally solved, notwithstanding the years which have elapsed, and the growth of the system since its introduction. A means whereby telegraphic messages can be received at high rates of speed in type or written character ready for immediate issue to the public or the Press, appears to be one of the desiderata of the future.

Next, in wireless telegraphy, there is the difficult problem of perfect tuning which will obviate all mutual disturbances between different wave-lengths, and in addition it can, I think, scarcely be said that we have arrived at finality in the matter of wireless receivers.

Then in telephony there are at least two fundamental problems which await solution. First, the invention of an effective telephone relay or repeater; and, secondly, a method of extending the range of communication in submarine cables.

Until recently all attempts to design a satisfactory telephone relay had failed, but the American Telegraph and Telephone Co. have now under trial an instrument termed an exalter, which, when placed in a suitable position on a long line, materially improves the communication. I tried this recently between New York and Chicago, and I hope shortly to have an opportunity of experimenting with it on our long-distance lines and cable circuits.

The largest multiple that can be fitted in practice on one board does not exceed 20,000 lines, and not only in London, but in several American towns, provision is being made in one building for numbers varying from 40,000 to 60,000 telephones, two or three separate exchanges being provided in one building. That this duplication and triplication of exchanges is the final solution of the of the problem no one would, I think, venture to predict, and as I have already hinted, there are are indications that the difficulty may be met in another manner.

The submarine cable problem for telephonic use is not an easy one, as gutta-percha, which, so far as our present experience goes, must be used in some form, has such a relatively high electrostatic capacity, that it has not been found practicable to use it for really long cables, and the problem of loading, which at first sight would appear to offer a solution of the difficulty, has not yet been met in a satisfactory manner.

Finally, I have little doubt that the progress of electrical means of intercommunication will in the future go on unchecked, and that those associated with and responsible for such progress will in the course of the next few years bring about such developments that they will be in a position to compare in no unfavourable manner the advance of these particular branches of our work with that which we can foresee in all other branches.

## PHYSICAL SOCIETY.

At the meeting held November 24th, 1905, Prof. J. H. Poynting, F.R.S., President, in the chair, a paper on "The Dielectric Strength of Air" was read by Mr. A. Russell. The dielectric strength of air, at a given barometric pressure, is generally deduced from the results of experiments made on the disruptive voltages between equal metal electrodes at given distances apart. It is assumed that the electric field surrounding the two electrodes just before the disruptive discharge takes place is similar to that round the electrodes at low voltages. Schuster has shown that this assumption is untenable. The author has found that in certain cases the dielectric has broken down before the final discharge takes place. Hence the boundaries of the Faraday tubes are no longer the surfaces of the metal electrodes, but the boundary of that part of the dielectric surrounding the two electrodes which has ceased to insulate and has become a conductor. It is known that for various gases there are certain minimum sparking potential differences between the electrodes. The electrostatic equations fail to take this into account. The author, therefore, makes the assumption that for distances apart greater than about a millimetre, when the disruptive voltage is v kilovolts, the effective P.D. between the ends of the Faraday tube which is subject to the maximum stress is $v - \epsilon$, where $\epsilon$ is the minimum sparking voltage. Applying the formulæ which he has deduced, using his assumption, to tests of Heydweiller, Steinmetz, Algermissen, &c., the author finds that they agree in making the dielectric strength of air 38 kilovolts per cm. approximately. A knowledge of this quantity enables us not only to find the disruptive voltages between electrodes of many geometrical shapes, but also to find the "critical" pressure for overhead electric power transmission at high pressures. The author gives a complete proof by Kelvin's method of images of the Kirchhoff series-formula, and shows how its numerical value can be readily found both by ordinary algebra and by elliptic function series.

A paper by Dr. H. A. Wilson and Mr. E. Gold, "On the Electrical Conductivity of Flames for Rapidly Alternating Currents," was read by Dr. Wilson. This paper contains an account of a series of experiments on the electrical conductivity of a Bunsen flame containing various alkali-salt vapours, for alternating-currents with frequencies from $7 \times 10^4$ to $11 \times 10^5$ alternations per second.

A paper "On the Lateral Vibrations of Loaded and Unloaded Bars" was read by Mr. J. Morrow.

## THE USE OF GAS FOR POWER AND HEATING.

By Ernest A. Dowson, A.M.I.M.E., M.J.I.E.

*Abstract of paper read before the Birmingham Association of Mechanical Engineers, April 27th, 1905.*

(*Concluded from page* 908.)

To meet special cases, the author referred to a modification where part of the gas is passed into a small holder, to be used for heating purposes in blow pipes and burners, while the rest is sucked away direct to the engines.

Explaining that all gases made in modern power plants were of the semi-water class, it was pointed out that whether *pressure* or *suction* methods are employed made but little difference to the gas evolved, and each application required full treatment of the merits of the case and local considerations to decide upon the most economical system to adopt.

To illustrate the economy effected by the use of semi-water gas plants, the following figures, covering a year's working, based on 50 weeks of 54 hours, were given:—

Annual Cost of Running Power Plants.

| | 25 B.H.P. | 100 B.H.P. |
|---|---|---|
| (A)—Electric motor, taking energy at 1d. per B.O.T. unit. Energy, allowing ¾ unit to develop each B.H.P.-hour ... | £205 0 | £820 0 |
| Interest, depreciation, &c., at 7½ per cent. | 4 10 | 11 5 |
| Totals ... ... ... ... | £209 10 | £831 5 |
| (B)—High-speed steam engine with Lancashire boiler. Coal: 5 lb. and 4 lb. per B.H.P.-hour, respectively, at 12s. per ton... | £90 8 | £289 5 |
| Water: 4 gallons per B.H.P.-hour, at 9d. per 1,000 gallons ... ... ... ... | 10 2 | 40 0 |
| Labour, at 15s. and 27s. per week respectively ... ... ... ... ... | 37 10 | 67 10 |
| Interest, depreciation, &c., at 10 per cent. | 35 0 | 100 0 |
| Totals ... ... ... ... | £173 0 | £496 0 |
| (C)—Gas engine on coal gas, at 2s. per 1,000 cb. ft. Gas at 17 cb. ft. and 15 cb. ft. per B.H.P.-hour respectively ... ... ... | £114 15 | £405 0 |
| Labour, 1 hour per day at 6d. ... ... | 7 10 | 7 10 |
| Interest, depreciation, &c., at 10 per cent. | 16 3 0 | 50 0 |
| Totals ... ... ... ... | £138 5 | £462 10 |
| (D)—Gas engine on semi-water gas. Coal: 1 lb. per B.H.P.-hour at 20s. per ton ... | £30 0 | £120 0 |
| Water: ¾ gallon per B.H.P.-hour at 9d. per 1,000 gallons ... ... ... ... | 2 0 | 8 0 |
| Labour, at one-third of Case B ... ... | 12 10 | 22 10 |
| Interest, depreciation, &c., at 10 per cent. | 25 0 | 65 0 |
| Totals ... ... ... ... | £69 10 | £215 10 |

With respect to the application of semi-water gas for the propulsion of vessels, a barge fitted with plant of the suction type, by Herr E. Capitaine, and a passenger vessel by Messrs. John I. Thorneycroft & Co., were referred to. While many knotty points had to be overcome before fast passenger vehicles could be dealt with, progress was expected in regard to heavy lorries.

After explaining the different cycles upon which modern gas engines worked, and the arrangement of cylinders adopted, a number of typical illustrations of modern gas engines were given and described, most of which have already appeared in our pages.

The difficulties to be combatted in dealing with the high temperatures resulting from the employment of large cylinders and high compression were reviewed, and the latest methods of super-compression by added air and cooled exhaust, by Mr. Dugald Clerk, and the Banki system of spraying a little water into the cylinder on the charging stroke, were described.

The advantages of low-tension magneto-ignition for large engines were touched upon, and diagrams were exhibited, showing that though the hit-or-miss system of governing was most economical, the system of throttling the charge gave a better turning moment at anything under full load.

The advantages of gaseous fuel over solid fuel for heating purposes were also taken into consideration, and the direction of economy pointed out, savings from 15 per cent. to 75 per cent. being realised by the use of semi-water gas instead of coal, or coal gas.

The obtaining of temperatures of 2,000° F. under conditions of perfect control was possible without air blast, while higher temperatures could be obtained by air blast and superheated gas.

Illustrations and particulars were given of several types of furnaces for heating purposes suitable for use with semi-water gas.

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In the discussion, Mr. A. E. A. Edwards gave an instance of a 7-H.P. steam engine connected to a vertical boiler which used 24 lb. of slack per H.P. per hour. Referring to a test of a 150-H.P. gas plant working at 100 H.P., the consumption of bituminous slack, over a period of four months, and taking into account all stand-by charges, was 1·8 lb. per B.H.P.-hour. With wages at 27s. per week, repairs estimated at about 5 per cent. on the cost of the plant, the cost of the gas, including fuel, wages, repairs, and 10 per cent. depreciation, came out at 0·2d. per H.P.-hour. Coal gas for the same engine would cost 0·5d. per H.P. Cost, with producer, two-fifths that of coal gas. The stand-by on this plant averaged 59 lb. per night and 90 lb. per week-end. The above were nothing like the best figures he had. A similar plant gave ·88 lb. common slack per B.H.P. at 11s. 9d. per ton, whereas in the other case the fuel cost 7s. delivered, or 3s. 6d. at the pit mouth.

In another case, the consumption of coal per H.P.-hour on a 50-H.P. plant working at 26 H.P. was 3½ lb. A compound condensing steam engine, working at 120 H.P. cost, including depreciation, wages, &c., £710 per year, or 0·65d. per H.P., of which the fuel cost 0·37d. The engine used 11 lb. of coal per I.H.P.-hour. In regard to the cost of oil for gas engines, he instanced one case where the fuel cost £315 per annum and the oil £280; this was in a vertical engine. Against this a Belliss engine of 150 H.P. in a year of 3,000 hours used 5 gallons of oil for the whole year.

Mr. B. J. Fletcher mentioned a steam plant of about 1,600 I.H.P. compound condensing, with superheaters, steam pressure 150 lb., in which the cost of fuel over a year, including all charges for handling and stand-by, came out at 0·15d. per I.H.P.-hour. The plant had been running from 8 to 10 years, and the above result was from actual working results, not a special test.

Mr. C. S. Hopkins gave the cost of a Dowson pressure plant at from £5 to £6 per B.H.P. per year of 2,800 hours, or 0·43d. to 0·51d. per B.H.P.-hour. In regard to depreciation, he considered that 10 per cent. at least, or even more, should be allowed, as frequently it is necessary to replace the plant in five or six years, before it is worn out.

As a good many members contributed their views and experiences to the discussion, we may turn to Mr. Dowson's reply for the principal points raised.

Replying to Mr. Edwards, the Author pointed out that "one cannot safely compare the merits of different systems of power production unless the specific cases taken are on approximately the same scale of working." In regard to the use of bituminous coal for gas-making instanced by Mr. Edwards, evidently these installations had been very carefully worked; at the same time they did not show any very solid advantage commensurate with their cost and complexity, as compared with gas plants using anthracite. He agreed with Mr. Edwards in taking 0·2d. per B.H.P.-hour as the average inclusive cost of working an engine on semi-water gas.

Regarding the consumption of oil instanced, he did not think this could be taken as typical.

Replying to Mr. Thornbery, the Author defended the use of small gas-holders for certain installations.

Answering Mr. Fletcher's question as to whether gas plants maintained their efficiency over a period of years, Mr. Dowson said that this was undoubtedly the case, and resulted from the extreme simplicity of this type of apparatus.

Answering Mr. Fletcher's inquiry as to the scale on which it would pay to install ammonia recovery plant, the Author said the smallest type standardised by the Power Gas Corporation was 3,000 B.H.P., though Mr. F. Grover had given the figure of 5,000 B.H.P., and this figure was borne out by other authorities. There were two by-products, tar, and sulphate of ammonia; the former was of a special nature and of little commercial value, while the market for the latter had been falling for some time. Mr. Hancock had referred to the proportion of hydrogen in gas for driving engines, and it was pointed out that an excess of hydrogen was not desirable, owing to trouble arising from the rapidity of its flame propagation.

The application of semi-water gas for heating furnaces, annealing, &c., was also discussed at some length, and the advantages of the use of gaseous fuel for these purposes were fully demonstrated.

## NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

(*Continued from page* 864.)

### I.E.S. Time Switches.

In the new edition of their list of "Time and Automatic Switches," the Improved Electric Supplies, Ltd., of 7, Great Newport Street, W.C., describe a number of their specialities. In these time switches the clock itself, which is, of course, the vital point, is made in England, and has a jewelled lever balance; it can be arranged for working with one winding for 8 or 28 days, is very solidly made of brass, is fitted into a dust-tight cover, and is of very solid construction. The switch (fig. 129) is doubly insulated from the clock in order to avoid electrolytic effects in the bearings, which are found to take place when double insulation is not provided. The switch movement is actuated by two small levers attached to the spindle of the clock, which revolves once in 24 hours. One of these levers impinges on the upper side of the "V" shaped ivory piece, which is rigidly attached to a spindle, in turn fixed to the middle of the mercury switch tube. The mercury switch tube is composed of a glass having two platinum contacts inside, one at the end of the tube and one at the

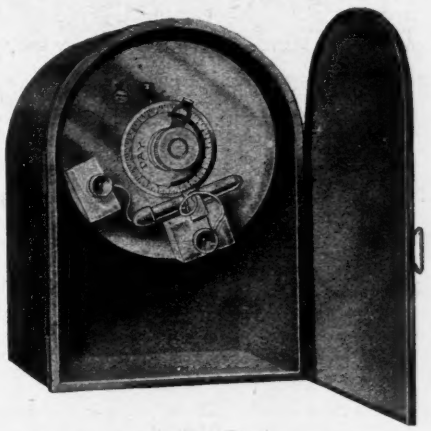

Fig. 129.—Mercury Contact Time Switch.

centre. The tube is half filled with mercury and about ¼ in. of oil to prevent arcing. The weight of the mercury running up the tube forms a quick break-and-make movement. The longer lever impinges on the under side of the "V" shaped piece, and tilts the mercury tube in the opposite direction. This mercury tube, we are informed, has been found to be very satisfactory in its working, in fact, it has been used for some months in conjunction with a flashing sign. The tubes have been making and breaking a 10-amp. circuit some thousands of times every evening for the last three months, without, we understand, any deterioration whatever.

The mechanical contact type is shown in fig. 130. The same clock is provided with this switch. The action is as follows:—Mounted on the 24-hour spindle is a dial and a collapsible concentric cam. This cam is capable of being extended to cover the whole of the 24 hours, or to be condensed so as

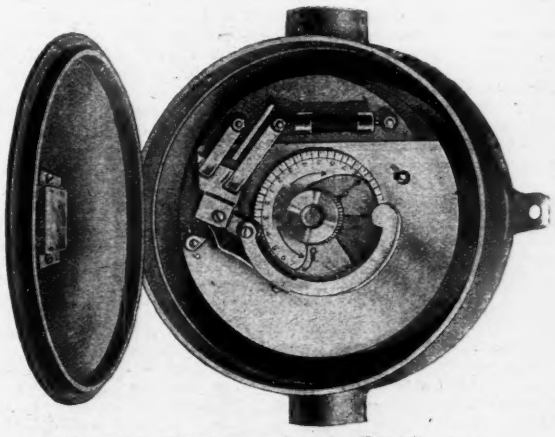

Fig. 130.—Mechanical Contact Time Switch.

to cover a period of only three hours. The arm carrying the switch contact itself is pivoted on to the clock case, and a small steel roller runs on the edge of the cam mentioned above. This cam gradually pushes the small steel roller out from the centre of the clock, and causes the moving contact to slowly approach the clips. A small trip is provided to hold the contact off the clips until the small roller reaches the position marked "on." This trip then allows the contact to smartly enter the clips and the contact is held in its position by the concentric cam until it comes into the position marked "off," when the roller falls over the edge of the cam thereby actuating the switch and breaking the circuit.

With this particular type of switch the actual work done by the clock is spread over a very long period, so as to prevent any undue strain being put upon the clock. By slacking back the milled headed nut the cam can be set in any position relative to the dial and to cover any period of time marked thereon.

Other recent publications by this company include illustrated lists of ironclad and cast-iron accessories, stage and window lighting appliances, electric batteries, torches and hand lamps.

## The Glasgow Arc Lamp Starter.

Mr. James Ferguson, late manager of the electrical department of Messrs. Kelvin & James White, Ltd., has started business on his own account, with works and offices at 61, Pollok Street, Pollokshaws, Glasgow. The equipment of the works is of the most modern kind, and adapted for the manufacture of light electrical and mechanical apparatus generally. He will shortly put on the market several specialities of interest to the electrical and engineering trade. One that he has already introduced is the Glasgow arc lamp starter (Lackie, Calderwood & McEwen's patent). A number of these starters have been in use on the Glasgow Corporation street lighting system for over eight months, giving, we understand, every satisfaction. Mr. Lackie is, as our readers are all aware, electrical engineer to the Glasgow Corporation, and Mr. Calderwood and Mr. McEwen are well-known members of his staff.

This apparatus has been designed for switching in street arc lamps with an interval of time between each group. The switch consists principally of two parts, viz.:—(1) A main switch proper controlled by an electro-magnet; and (2) the time element mechanism which closes a secondary circuit after a pre-determined interval, thus actuating the main switch of the next set in the series. From any central or suitable point a series of lamps may

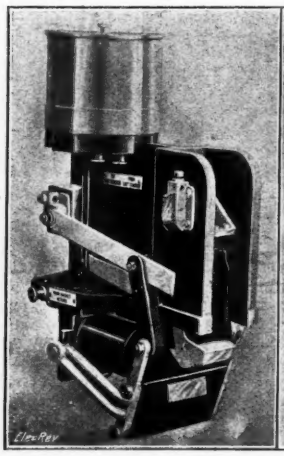

Fig. 131.—Starter in "Off" Position.

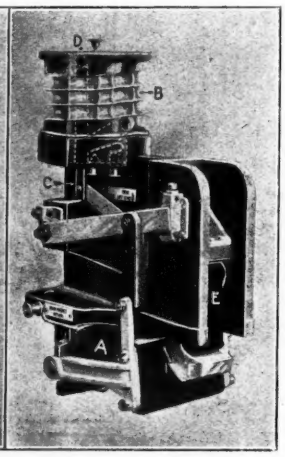


Fig. 132.—"On" Position.

be switched into circuit, set after set of the series, with a time interval between the switching in of the various sets; on the last of the sets being switched in, contact is automatically made to indicate at the central switching point that the circuits have been completed throughout the entire series. The interval of time obtained between the lighting of one set or group of arc lamps, and another set or group of arc lamps, permits of the electric current being steadied to obviate flickering of the lamps of private consumers.

The electro-magnetic switch is actuated by a powerful electro-magnet A (fig. 132), rotating an armature which is pivoted by arms to the yoke. This armature is coupled by insulated connecting pieces at the sides to the double-pole switch, which is provided with suitable carbon contacts. One of the switch coupling-pieces is fitted with an arm which is coupled to the plunger C, which actuates the time element mechanism. The whole apparatus is fitted on a base of insulating material, with an insulating partition between the two switches, so that accidental contacts between the positive and negative terminals, or between the positive or negative terminals and the middle wire terminals, may be made difficult or impossible.

The time element mechanism consists of a wavy spiral B (fig. 132), the axis of which is vertical, mounted on a platform forming part of the insulating base. Through the centre of both the spiral piece and the base is a hole large enough to allow a plunger C to pass freely up and down. The function of this plunger is to elevate a smooth spherical ball D from the bottom of the base to the top of the spiral. The ball then descends by travelling round the zig-zag till it reaches the base, where it rolls on to the top of the contact spring, pressing it down against the fixed contact, and closing the circuit for the relay magnet of the next starter. The time taken for the ball to travel from the top till it closes the circuit for the next switch is 11 seconds, or sufficient to allow one group of lamps to be burning steadily before the next group is switched on. When the starter is switched out, the plunger drops to the bottom, and the ball rolls off the contact spring on to the top of the plunger, ready for the switching-in operation. The white dotted lines in the figure show the travel of the plunger and ball. A clutch F, which can be released by the electro-magnet E, holds the switch on. As soon as the "all on" lamp in the station lights up, indicating that all the groups of lamps in the series have been switched on, the switch for the electro-magnet A may be opened, and the switches are held on mechanically. To open the switches, the main magnet or "in" switch is first closed, thus relieving the clutches F, which are withdrawn on closing the "off" switch, which controls the circuit for the electro-magnet.

The whole apparatus is of substantial construction, and has been designed for fitting in section pillars or lamp pillar bases. It is claimed that a very great saving in cost of arc street lighting, in men's time, and in current consumed, is effected by the use of these arc starters.

## A New Screw.

Fig. 133.

The accompanying small illustration (fig. 133) shows Ballantyne's improved stud screw, which has been introduced to get over the unsightliness of ordinary round-headed screws, as used in the fixing of electric light fittings, flush switch plates, and many other ways. By means of this simple invention, a first-class finish can be obtained. It is being sold by Mr. Wm. Anderson, 212, Bath Street, Glasgow.

## Extra High Tension Voltmeters.

Messrs. Galileo, of Florence, have introduced instruments reading direct to 200,000 volts; these are modelled on the simple principle of electrostatic attraction, but the designers state that they have found it extremely difficult to work out the practical details. Two ranges have been designed, one reading up to 120,000 volts, the second to read up to 200,000. A section through the latter is shown (fig. 134). A and B form the terminals; C and P are electrically

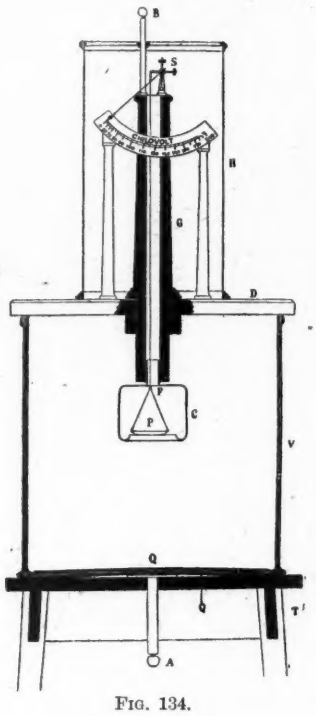


Fig. 134.

connected together, and to B. Q and $Q_1$ are sheets of metal on opposite sides of the surrounding glass vessel V, into which only one pole enters. The object of Q is to afford a well-defined equipotential surface. The attraction of the disk P towards A is measured on the scale—extending over an arc of 60°—by the long pointer. These instruments are mounted on ebonite bases, supported by wooden legs.—*L'Elettricista.*

## AMERICAN ELECTRICAL EXPORTS IN 1904.

By W. POLLARD DIGBY.

Following the practice of reckoning electrical exports as taking place to certain trade zones, which the writer has adopted in his preceding contributions to the Electrical Review on the subject of electrical export trade, comparisons of the following figures with those of preceding years can be easily made. First, a word as to the sum total of the two chief headings under which American electrical exports are classed. Electrical machinery had, for the 1904 fiscal year, an aggregate value of $5,645,809 as against $5,779,459 for 1903. Instruments and apparatus for scientific purposes (including telegraph, telephone, and other electric appliances) amounted in the aggregate to $4,861,204 as against $4,206,617.

Examining the distribution to various markets in 1904 the following figures are obtained :—

| | Electrical machinery. Dollars. | Instruments and apparatus. Dollars. |
|---|---|---|
| United Kingdom ... ... | 1,323,019 | 1,522,849 |
| Rest of Europe... ... ... | 472,465 | 666,700 |
| British North America... ... | 1,406,252 | 664,793 |
| British Africa ... ... ... | 101,393 | 179,869 |
| British Australia ... ... | 282,541 | 64,655 |
| British East Indies ... ... | 197,440 | 121,795 |
| Other British Possessions ... | 31,203 | 183,308 |
| South America... ... ... | 273,724 | 291,219 |
| Other foreign countries ... | 1,558,949 | 681,368 |

Comparing the exports of electrical machinery to the various zones with those obtained in the previous year (1903), decreases occur to the United Kingdom of nearly $1,000,000 (the 1903 figures were $2,256,062), to British Africa of about $21,000, and to South Africa of $136,000. Against these we have to set the following increases :—

Rest of Europe, $148,000; British North America, $166,000; British Australasia, $82,000; British East Indies, $172,000; to other foreign countries, $341,000. The bulk of this latter item is due to a great increase in the exports to Japan, from $428,427 in 1903 to $884,792 in 1904.

So far as instruments and apparatus are concerned, decreases only occur in regard to British Africa, $130,000; to British Australasia, $28,000; and other foreign countries, $232,000. The following increases have occurred :—To the United Kingdom, $452,000; to the rest of Europe, $272,000; to British North America, $198,000; to British East Indies, $72,000; to other British possessions, $90,000. The trade to South America has remained practically constant.

With regard to the figures concerning the United Kingdom, if we had been living under the Protectionist *régime* so earnestly desired in certain quarters, the decrease in imports of electrical machinery from the States would have been at once attributed to the beneficent action of the tariff, while if a growth of the imports of instruments and apparatus had occurred, there would have been clamourings for higher import duties. Yet, under the present system, we have a decrease under the heading of machinery, which is double that of the increase under the heading of instruments and apparatus. This, by the way, is an illustration, not an argument, for none should presume to argue fiscally by comparisons of two selected years, no matter whether adjacent or remotely separated.

## OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"G. S." writes:—"We have noticed with interest your remarks and notes in recent numbers of the Electrical Review *re* Municipal Wiring, and should be glad to hear whether you consider that the Corporation Electric Supply Department are acting within their powers in the following cases, in which we think that they are competing unfairly with the electrical contractors of the town:—

"1. In fixing (and we believe supplying) electrical illumination signs outside business premises.

"2. In offering to supply and fix with all the necessary wiring, &c., arc lamps to light a large public hall, free of charge to the proprietor of the hall, the revenue to be obtained from the supply of current for the lamps.

"3. In taking down, repairing and refixing, free of charge to the owners, of arc lamps which, from having been in use for some years, require a little to be done to them."

*** "G. S." does not say anything with regard to the provisional order under which the local authority of his district supplies electricity. Much will depend upon the terms of that order; and unless the Corporation have secured the insertion of a clause permitting free wiring, it is anticipated that their doing so is *ultra vires*.

Some local authorities have expressly obtained these powers. Thus by the Nottingham Corporation Act, 1899, 62 and 63 Vict. c. ci., Sec. 40, power is conferred to provide (but not to manufacture) "lamps, meters, electric lines, fittings, apparatus, and things for lighting and motive power, and for all other purposes for which electric energy can or may be used, or otherwise necessary or proper for the supply, distribution or consumption of electric energy." "G. S." should apply to the Corporation for a copy of their provisional order, with which they must supply him at a price of not less than 1s. If he cares to send it to this office, the provisions relating to wiring, &c, can be fully explained.

"S." writes:—"A Corporation, A, having no Parliamentary powers to take from or give a supply of electrical power to any person outside its supply area, has received an application from a consumer for a supply of power in bulk. A's radius would be terminated at the consumer's existing power station inside A's area, but the consumer's private mains would convey A's energy to points outside this area, being the area of another local authority, B. B is quite prepared to agree to A doing this, on terms, and I want to know if A and B can arrange this by agreement and without Parliamentary powers. There is no company's area in question, and the matter apparently only affects A and B."

*** The short answer to "S" is to be found in Sec. 4 (2) of the schedule to the Electric Lighting (Clauses) Act, 1899, which provides that the undertakers shall not at any time after the commencement of the order supply energy or (except for the purposes of that order) erect or lay down any electric lines or works beyond the area of supply, otherwise than under the authority of Parliament or under a licence granted by the Board. It has been held in a gas case (Gas, Light & Coke Co. *v.* South Metropolitan Gas Co., 62 L.T. 126) that where there is a clause of this kind, and the premises are situate on the border line separating districts A and B, gas cannot be supplied by the A company to be used in that part of the premises which extends into B. It is submitted that the same principle applies to electricity. Agreement between the two Corporations will not supply the want of statutory power.

## THE YOUNG IDEA.

[COMMUNICATED.]

*Scene.*—Engineer's office at power station.
*Time.*—Office hours, any day, all the year round.
*Curtain lifts and discloses engineer surrounded by papers, drawings, files and baskets, deeply engrossed in manipulation of inevitable slide-rule.*

Enter, after knocking, portly dame in red hat, trimmed to overflowing with green feathers, and wearing complete week-end costume.

She advances against the engineer, smiling fearfully, draws a chair to her, sits down in a strategic enfilading position, and opens fire thus:

*P.D.*—I think you look after the electricity engines, don't you? This electricity is such a wonderful thing, isn't it? It always puzzles me, you know, but I *should* like to find out all about it. My husband's brother's brother-in-law does a bit at it in his spare time; you know him, I daresay—Tom Jones, lives just a few doors down our road; I'm Mrs. Hawkins, 101, Bell Street—put that down so's you don't forget it. As I was saying, he's a clever chap, Mr. Jones is, knows all about the bells, and puts our electricity to rights when he comes round to have a bit of tripe with us—won't you come one evening to meet him, he'd be very pleased, I'm sure? No formalness about him, you know.

Well, as I was just going to say, when you put it out of my head, this young feller used to try to explain all about the electricity and magneticism to me and Hezekiah—that's my husband, you'll like Hez.—but I couldn't keep up to him, and I says: "You're too clever for me, Tom, I says, but you give it to Henry"—that's my boy, he's 14 come Michaelmas—"you give it all to him, and praps he'll make an electricianer one day. So Tom tells the dear lad all about the positives and negaltives, and how he's never to touch anything painted red, because its sure to be magneticised and might kill him dead, and he shows him what he calls experiments with rulers and sealing wax picking up things; so that Henry knows nearly as much about it as Tom, and is for ever cutting the bell-wires and joining them up again, and stopping the bells ringing, until I wish he wasn't so clever.

Well, what I came here for was to ask you whether you can find him something to do about your engines. He wouldn't want much to begin with, because he might have to be taught a few little things—place might be a bit strange like—but you'd find him a clever lad. Now, what do you think about it?

*Engineer.*—Madam, at the present moment I am incapable of thought. If you would be good enough to leave your address—oh! yes, I have it here—I will communicate with you later. Good morning m'a'm.

*P.D.* (rising).—Thank you very much. I forgot to show you his photo. Here it is, but I always say it isn't very flattering. (Hands cabinet photograph of sickly looking youth dressed in a black suit that looks as if it had been cast on him, standing straight up with heels together, one hand stiff at his side and the other resting—planted would be a better term—on a couple of large books, which lie on a wool-work mat at the edge of an oval table with one central leg.) Praps you would like to keep it by you for a day or two. I'm sorry you can't give me an answer now, but I'll call round again in a day or two. It's no trouble at all, thank you, because I often have to be passing. Good morning, sir. I am glad to see you looking so well. Any evening you like to call we shall be glad to make you welcome. Good morning. I wish I had time to stop and find out something about this electricity. Such a wonderful thing, I always say, and (looks at engineer admiringly) I suppose *you* know *all* about it. Well, good morning, I hope I have not interrupted your business at all, but I expect you are glad to see

people sometimes, it must be so lonely up here all by yourself. What a funny card! What does it say, "For every minute I am delayed I have to work overtime!" Well, I never! You don't mean to say they're that hard on you? I wouldn't have Henry treated like *that*! What a shame! Well, of course, they can't say I've delayed you, because I came on business. Good morning (leaves).

*Engineer.*—Good morning, madam. (Presses one of a row of buttons on his desk. Presently enter boy.)

*Engineer.*—If you ever show that woman up here again you young scoundrel I'll break your silly little head!

(*Curtain falls on boy expostulating, and then dodging something heavy.*)

## NEW PATENTS APPLIED FOR.

**Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.**

23,863. "An advertising device for electrical station indicators." J. Esser. November 20th. (Complete.)

23,889. "Improvements relating to automatically cutting off the current from electrically-heated furnaces, stoves or other apparatus at any desired temperature." H. E. Newton. (Klewe & Co., G.m.b.H., Germany.) November 20th.

23,894. "Improvements in and relating to electric switches." The British Thomson-Houston Co., Ltd., and J. M. Wallace. November 20th.

23,904. "Improvements in connection with monophase electric motors." Felten & Guilleaume-Lahmeyer-Werke Aktien-Gesellschaft. (Date applied for under Patents Act, 1901, November 21st, 1904, being date of application in Germany.) November 20th. (Complete.)

23,934. "Improvements in or relating to electrical distribution systems." A. J. Boult. (J. Lester Woodbridge, United States.) November 20th. (Complete.)

23,976. "Improvements relating to combined electric motors and air compressors." The Phœnix Dynamo Manufacturing Co., Ltd., and R. Pohl. November 21st.

23,997. "Improvements in electric telegraphs." Siemens Bros. & Co., Ltd., and G. S. Grimston. November 21st.

24,025. "Improvements in and relating to vapour electric apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 21st.

24,058. "Improvements in elastic suspension devices for the electric motors of tramcar and like trucks." M. B. Mountain, G. M. Gibson and A. F. H. Head. November 22nd.

24,061. "Improvements in electric arc lamps." H. Bevis and A. E. Angold. November 22nd.

24,106. "Improvements in operating rotating apparatus by means of single-phase commutator electric motor supplied for polyphase circuits." R. Braun. November 22nd.

24,115. "Improvements relating to pirn-carrying tubes of electric weft protectors and other purposes." F. Fougerat. November 22nd.

24,139. "Improvements in magneto or dynamo-electric machines." H. Guillou. November 22nd.

24,141. "Improvements in dynamo-electric machines." The Hon. C. A. Parsons and A. H. Law. November 22nd.

24,158. "A prepayment mechanism and switch in connection with the prepaying of rentals or instalments for hire-purchase, in respect of apparatus or wiring in connection with installations of electric light, heat or power." F. H. Merritt. November 23rd.

24,162. "Improvements in obstruction removers applicable to electric tramcars or the like." J. R. Hudson. November 23rd.

24,183. "Improved controller finger contact for electrical work." F. E. Imeson. November 23rd.

24,184. "An automatic life-guard or cut-out for overhead electric wires." J. E. Newton. November 23rd.

24,187. "Improvements in apparatus for the control of electro-magnetic power hammers, drop stamps, presses and the like." T. H. Large. November 23rd. (Complete.)

24,197. "Improvements in or connected with the control of electric motors used in connection with secondary or storage batteries." W. N. Stewart. November 23rd.

24,200. "Improvements in devices for electrically lighting inverted gas burners." P. Benard. (Date applied for under Patents Act, 1901, November 26th, 1904, being date of application in France.) November 23rd. (Complete.)

24,213. "Improvements in make-and-break apparatus suitable for induction coils." F. G. Loring. November 23rd.

24,235. "Improvements in electric motor controlling devices." The British Thomson-Houston Co., Ltd. (The General Co., United States.) November 23rd.

24,236. "Improvements in and relating to electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 23rd.

24,249. "Improvements in and relating to electrical contact breakers of explosion engines of motor vehicles." W. J. Charles and A. Watson. November 24th.

24,268. "Improvements in the section and form of conduit in the method of laying it in connection with tramway rails and placing within it an electric conductor and in the manner of applying a brush or pulley from a car to the said electric conductor." H. J. Peddie. November 24th.

24,280. "Improvements in electric interlocking of railway signals with block telegraph instruments." W. R. Sykes, jun., F. T. Hollins, and F. W. Leake. November 24th.

24,281. "Improvements in electrical block indicators for railway gate crossings." W. R. Sykes, jun., F. T. Hollins, and F. W. Leake. November 24th.

24,293. "Improvements in contact breaking devices for magneto-electric ignition apparatus." W. Roos. November 24th. (Complete.)

24,302. "Improvements in mechanism for automatically actuating electric switches or contacts or apparatus for regulating the supply of electricity at different rates or for similar purposes." J. M. Tourtel. November 24th.

24,303. "Improvements in switch-releasing mechanism for coin-freed electricity meters." J. M. Tourtel. November 24th.

24,316. "Improvements in electrical generators or motors." S. Jevons November 24th.

24,325. "Improvements in or relating to electric conductors." A. J. Boult. (H. E. Knight, United States.) November 24th.

24,339. "Improvements in junction boxes and similar apparatus for the connection of electric cables or the like." A. T. Dawson and A. P. Pyne. November 24th.

24,383. "Improvements in electric switches." J. A. Hirst and P. S. Brook. November 25th.

24,403. "Improvements in apparatus for controlling electric circuits." British Westinghouse Electric and Manufacturing Co., Ltd. (The Westinghouse Electric and Manufacturing Co., United States.) November 25th.

24,421. "Improvements in dynamo-electric machines." L. Torda. November 25th.

## PUBLISHED SPECIFICATIONS.

**Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).**

### 1904.

Apparatus for Use in the Distribution of Alternating Electric Current. A. F. Berry. 22,164. October 14th.

Means or Apparatus for Regulating the Difference of Potential Between Portions of Electric Current Distributing Systems. A. F. Berry. 22,969. October 17th.

Arc Lamps. J. M. Wellington and W. F. Daniel. 22,522. October 19th.

Methods of Exciting Electro-Magnets by Alternating Electric Currents. M. Latour. 22,631. October 20th.

Vacuum Brake Apparatus for Electrically-Operated and other Trains. J. Gresham, H. E. Gresham and G. Keirman. 22,962. October 25th.

Regulation of Alternating Electric Distributing Systems. British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts Ges.) 23,205. October 27th.

Electric Clocks and the like. I. H. Parsons and A. E. J. Ball. 24,620. November 14th.

Treating the Contents of Electrolytic Cells. J. Hargreaves. 25,331. November 22nd.

Systems of Electrical Distribution. British Thomson-Houston Co., Ltd. (General Electric Co.) 26,588. December 6th.

Electric Switches. British Thomson-Houston Co., Ltd. (General Electric Co.) 26,589. December 6th.

Apparatus for Forming Devices for Holding or Suspending Overhead Electric Conductors, or Trolley Wires or the like. A. E. Winslow. 26,603. December 6th.

Apparatus for Electro-Deposition of Metals. B. M. Bailey. 26,849. December 9th.

Electro-Static Wattmeters and Watt-Hour Meters. E. Wilson. 27,201. December 13th.

Electric Dry Batteries. C. A. Day. (Empire State Dry Battery Co.) 29,138. December 30th.

Apparatus for Opening and Closing Electric Circuits at Pre-Determined Times. J. Gunning. 29,281. December 31st.

### 1905.

Electrical Contact Breakers and Switches for Igniting the Explosive Mixtures of Petrol Motors and other Gas and Oil Engines. R. H. Jones. 883. January 17th.

Thermal Electric Cut-Outs or Fuses. British Thomson-Houston Co., Ltd. (General Electric Co.) 2,491. February 7th.

Electric Lampholder with Locking Device to Prevent the Withdrawal of a Lamp Therefrom. H. Hirst and H. Bevis. 2,894. February 13th.

Control of Electric Motors. W. Geipel and F. M. T. Lange. 3,177. February 15th.

Telephone Cables. A. Whalley. 4,131. February 28th.

Telephone Apparatus. R. Bines. 4,166. February 28th.

Induction Coils. R. Bines. 4,167. February 28th.

Telephone Systems. R. Bines. (Date applied for under Patents Rule 9, February 28th, 1905.) 4,167a. February 28th.

Electric Cut-Out Switches. J. Frechette. 7,617. April 10th.

Manufacture and Production of Bobbins for Electrical Measuring Instruments. Hartmann & Braun Akt.-Ges. (Date applied for under International Convention, June 16th, 1904.) 11,442. May 31st.

Means by which Electrical Bells may be Employed on High Tension Circuits. F. Agaggio. 11,770. June 5th.

Telegraphic Receiving Apparatus. S. D. Field. 12,914. June 22nd.

Signalling by Electro-Magnetic Waves. R. A. Fessenden. 13,678. July 3rd

Method and Apparatus for the Manufacture of Electrical Condensers. Siemens Bros. & Co., Ltd. (Siemens & Halske Act.-Ges.) 13,682. July 3rd.

Apparatus for Supplying Electrical Energy to a Network by the Aid of an Auxiliary Current Generator and an Auxiliary Line Wire. Siemens Bros. & Co., Ltd, (Siemens, Schuckertwerke G.m.b.H.) 14,209. July 10th.

Trolley Retrievers for Electric Tram Cars and the like. C. J. Earl. 1,224. January 21st.

Incandescent Electric Lamp Sockets. British Thomson-Houston Co., Ltd. (General Electric Co.) 1,400. January 24th.

Means for Electrically Turning On and Lighting Up Gas Lamps, and Particularly those whose Burners are Beyond Reach of Hand. W. Pare. 1,762. January 30th.

Protector or Cover for Electric Conductors, Pipes, or the like. O. Wilhelmi. 2,579. February 8th.

Protective Devices for Electric Circuits. British Thomson-Houston Co., Ltd. (General Electric Co.) 2,789. February 10th.

Combined Electric Coupling and Two-Way Plug. H. Stokes. 3,049. February 14th.

Compensating Poles for Dynamo-Electric Machines. Elektrizitäts Act.-Ges. vorm W. Lahmeyer & Co. (Date applied for under International Convention, April 16th, 1904.) 4,858. March 8th.

Electro-Magnetic Brakes. British Thomson-Houston Co., Ltd., and C. B. Larzelere. 4,881. March 8th.

Electrically-Operated Pianos. J. Weber. 5,042. March 10th.

Electric Insulators. A. G. Bloxam. (H. Goffin.) 5,049. March 10th.

Electrically-Propelled Vehicles. A. Weiss. 7,036. April 3rd.

Safety Appliances for Exposed Electric Conductors. J. C. Thorne. 8,524. April 20th.

Dry Battery. F. Westherill. 8,631. April 22nd.

Combined Electric Switches and Fuses. Callender's Cable and Construction Co., Ltd, and J. C. Ward. 10,669. May 22nd.

Alternating Current Measuring Instruments. E. Conrad and W. M. Bradshaw. (Date applied for under International Convention, May 27th, 1904.) 11,036. May 26th.

Galvanic Battery Plates. H. C. Hubbell. 11,862. June 6th.

Electric Conductors and Methods of Insulating the Same. British Thomson-Houston Co., Ltd. (General Electric Co.) 13,383. June 29th.

Cluster Electric Lamp Socket. W. Fairweather. (Benjamin Electric Manufacturing Co.) 13,425. June 29th.

Devices for Electro-Magnetically Influencing the Arcs of Electric Arc Lamps Working with Alternating Current. T. L. Carbone. 15,591. July 29th.